MAY 1948

IN THIS ISSUE:

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Public Works Magazine

OHIO STATE UNIVERSITY
MAY 25 1948

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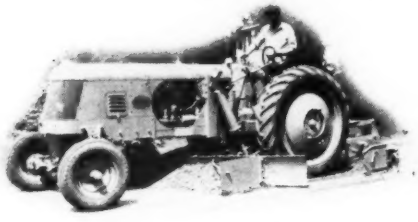

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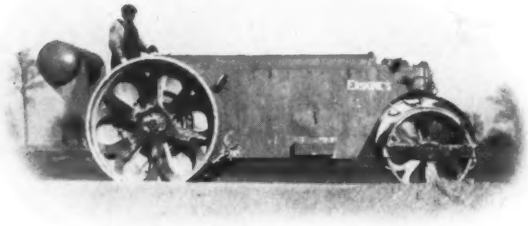

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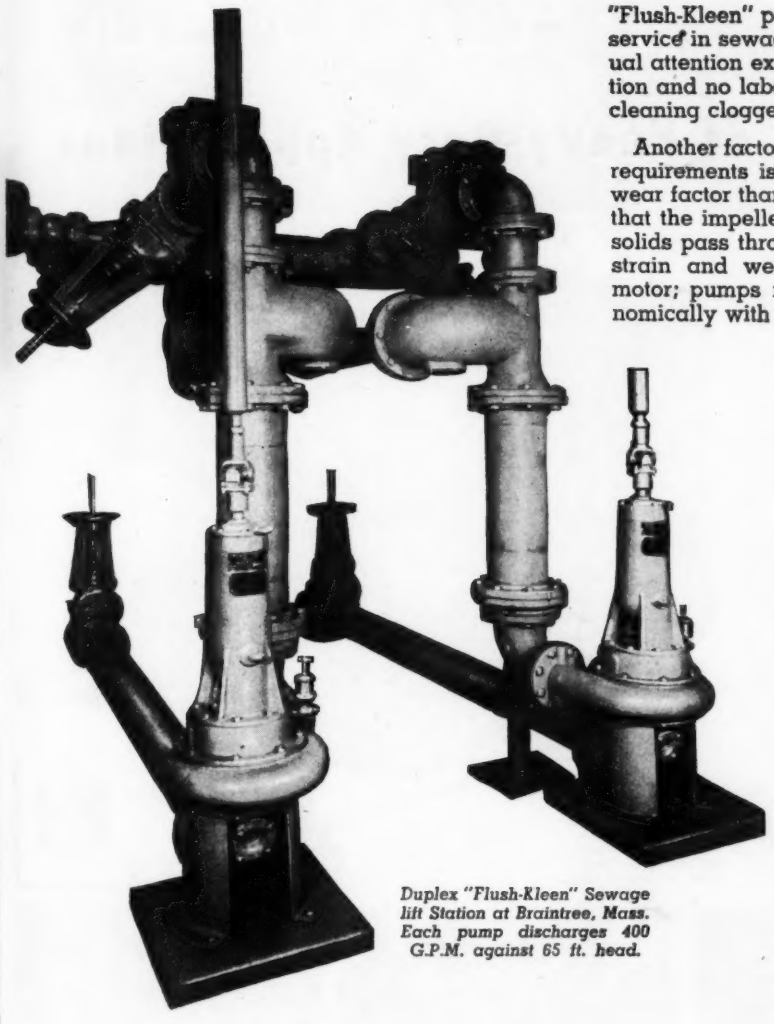

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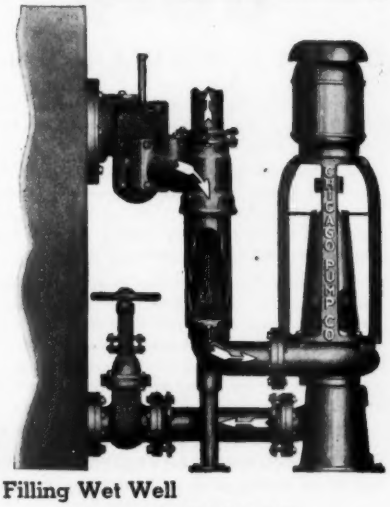

Filling Wet Well

- Sewage flows through inlet pipe.
- Coarse matter is retained on strainer.
- Strained sewage flows through idle pump to wet well.

Pumping

- Strained sewage is pumped from wet well.
- Coarse matter is backwashed from strainer.
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MAY, 1948

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VOL. 79, NO. 5

W. A. HARDENBERGH and A. PRESCOTT FOLWELL
Editors

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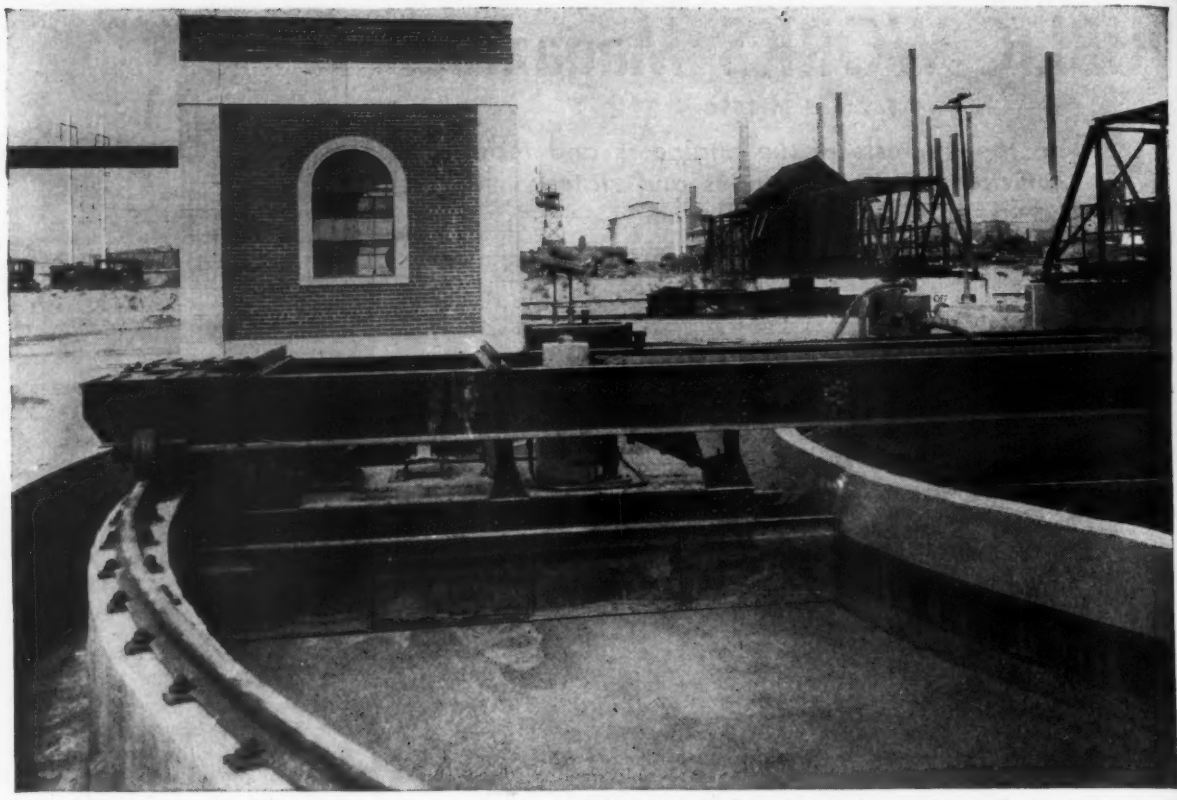

Magnetite Filter, built by Filtration Equipment Corporation, New York City, operating in an Eastern sewage treatment plant. Everdur Alloys used for cleaner housing, leveling blades, reinforcement bars and assembly bolts and nuts.

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The Editor's Page

Cold Weather Creates Engineering Problems

Winter brings on a good many problems to the engineer. Fifty years ago we could pretty much hole up for the winter, and sweat it out beside the fire in our red flannel underwear. It is not so easy today. Our economy will not permit the old-time winter vacation. Roads must be kept open; water must be supplied; sewage and garbage must be disposed of; and, generally speaking, our routine of life must continue no matter what the weather. When a real interruption does come, such as the east had when the big snow of last winter came unexpectedly, we find how disastrous it can be if not properly planned for.

Just to see how people live where it is really cold, and to get a little more cold weather background, your editor took a trip north recently. It was 35 below zero the day he left the north country (the latter part of April) so he had a little experience. He found that people get along pretty well under such conditions, but you have to think about what is going to happen when it gets cold and you have to prepare for it in advance. Cold weather engineering is like any other engineering, in that you take a realistic view of what may happen and then you get ready for it.

Sabotage and Bacteriological Warfare

These are days of stress and tension, and it is only natural, perhaps, that men are talking fearfully of the dangers to our communities from such things as bacteriological warfare and sabotage. Yet we believe that the dangers recited quite regularly by speakers, and reported in the newspapers, are considerably overdrawn.

It should ease the minds of our responsible municipal officials to look at the problem from the other side of the fence. For instance, let the water works superintendent put himself in the position of the possible foreign agent. He has a cellar full of dynamite; he has an ice-box full of germs; and he has 200 pounds of good strong virulent poison. This is a lot more stuff than any saboteur could reasonably be expected to accumulate; but for good measure let's throw in the services of 4 or 5 husky accomplices.

Now, with all this lethal material, what could a water works superintendent, who certainly knows the weak points of his plant better than anyone else, do to put a water system out of operation or injure any large number of residents. We must assume of course that the water plant is being run properly, that a chlorine residual is present in the water, and that, it being a war-time period, there is a reasonable amount of attention being given to guarding critical portions of the plant.

We believe that it would be difficult to put most plants out of operation for any considerable period of time, or to do very much damage that could not be repaired quite quickly. Trouble, yes; and cost and energy, but mighty little permanent or lasting damage. Many of our readers won't believe this until they have figured how little water can be made dangerous with 200 pounds of poison; how few germs can reach consumers in a well-chlorinated water; and how small an area of damage can be expected from even a cellar full of dynamite.

Two-way Radio for Better Service to the Community

Radio communication is an essential element in the efficient service of water supply to the people of the important cities of the United States, according to the American Water Works Association. It permits the maintenance of effective contact between operating and maintenance personnel and the supervisory staff, not only during normal times, but also during emergencies. It is not only a safeguard, but an economy in that it permits closer and more effective control of operations with a minimum of lost time.

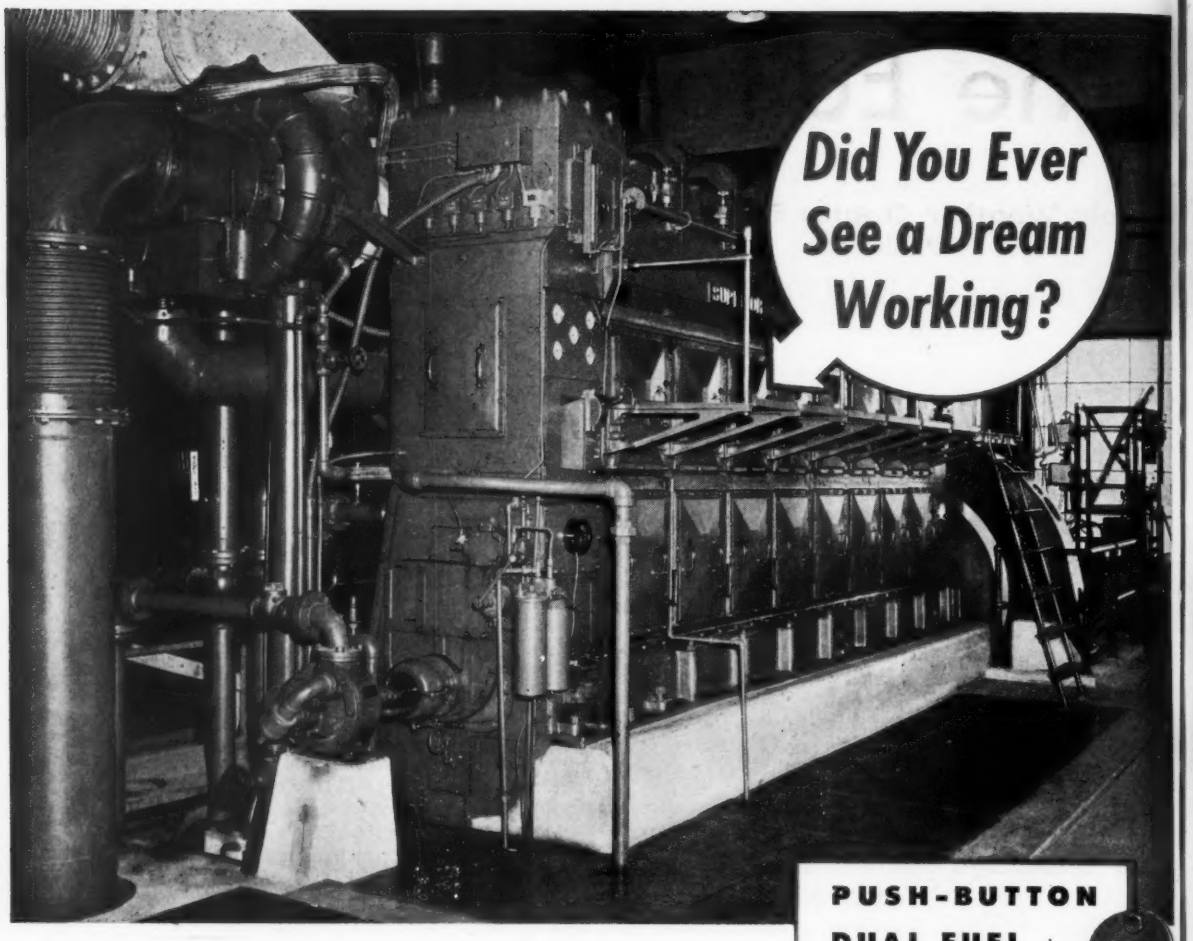
The same is true for many other municipal services. The efficiency of snow-removal operations has been greatly increased and the equipment needed to keep roads open has been markedly reduced in county and state work. The same is true of highway maintenance; and in the larger cities it is the case with street maintenance. It is believed that in refuse collection, 2-way radio might also prove economical. It would reduce missed collections with the necessity of using special pick-up trucks.

The channels available for municipal and county public works are now being allocated, and it is possible that late comers in this field will find none remaining for them to use. It's time to go!

Other Sciences Can Help Engineers

Engineers and other technically trained men are often a little narrow in their viewpoints and they often hesitate to call on other scientists for assistance. Fortunately, there seems to be a growing tendency to appreciate and make use of the knowledge of other specialists. For instance, highway engineers have found that soils engineers are essential in highway design and construction; and in California, geologists have proved to be of particular value in interpreting underground conditions and recommending methods of construction best adapted to them. Sanitary engineers have found that entomologists are essential in gathering and helping to interpret the data on which to base a sound insect control program; and the same is true of biologists and rodent control.

The best engineer is the one who can utilize the various scientific skills available to produce the most effective results. As a step in bringing together the engineers and the allied scientists with whom they should work closely, we would like to recommend that more of the programs of engineering meetings contain papers by scientists in related lines of work. Doing this would broaden all of us and would result in sounder application of scientific principles.



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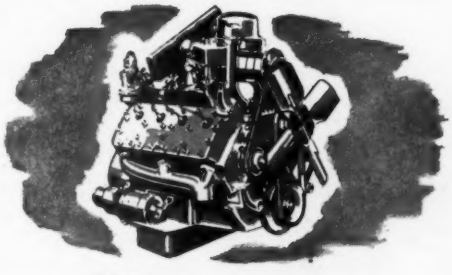

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FROM OUR READERS

HELP WANTED:

The Editor.—We are interested in obtaining information on some magnetic device that can be attached to a truck and driven through our plant driveways to remove nails, tacks, and metallic objects which are damaging our pneumatic truck tires. Your name was given us by the City of Birmingham, and we hope that you will be able to give us the information desired.

CLYDE E. HAGLER, VICE PRESIDENT,
Continental Gin Co.,
Birmingham 2, Ala.

(Ed. Note: Will our readers please send such information as they have on this subject to Mr. Hagler? Several of these units have been developed by State Highway Departments, but none that we know of is available for sale.)

THANK YOU:

The Editor.—Your reprint "Handbook of Trickling Filter Design" has just been delivered to this office and I wish to extend my congratulations to your editorial staff for having decided to reprint this series of articles. It will undoubtedly be of great value to engineers and superintendents in the design, construction and operation of trickling filters.

The writer has followed the practice in the past of clipping and filing articles appearing in PUBLIC WORKS which I expect to be af value in the design, construction and operation of the various public works carried on by this municipality. I have recently completed plans and specifications for a 16-inch cast iron main to be constructed by contract during the coming season. In preparing these specifications, I was greatly assisted by a series of articles appearing in PUBLIC WORKS beginning in October, 1943, "Trenching and Laying Sewer and Water Pipe." This series appeared while I was serving in the Navy Civil Engineer Corps in the Pacific Area, but fortunately the issues containing the articles had been piled in my office and were still there when I returned. However, very few of the issues of 1942-43-44 and 45

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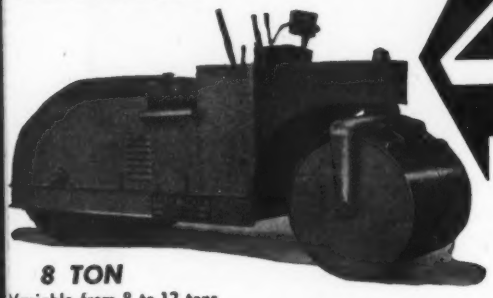

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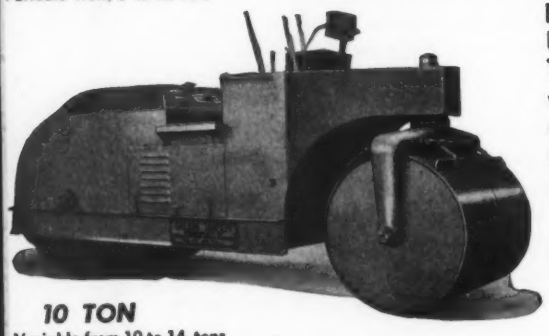
Variable from 8 to 12 tons



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were saved, and I regret that I have never seen such articles as the following, which have been mentioned from time to time in recent issues of your magazine:

- Operation of Sewage Treatment Plants
- Operation of Water Treatment Plants
- Water and Sewage Chemistry and Chemicals
- Hydraulics Simplified
- Methods of Computing Flow in Water Mains

All of these would be of great value to engineers who plan and execute public works improvements and this letter is written with the hope that it may influence you to reprint such material for the benefit of those engineers who missed the original publication during the war years. I am confident that such reprints would meet with an appreciative reception. Also, I wish to express my admiration for your editorial policy which has resulted in the production of a magazine of maximum value to men charged with the actual execution of public works projects.

J. A. CLULO,
Supt. of Public Works and City Engr.
Marquette, Mich.

ARMY RESERVE OFFICER:

The Editor.—For some time I have intended to write and congratulate you on the editorials that you have been writing about the reorganization of the army and the plight of the engineers. It appears that everyone else is either afraid to take a stand or is not interested. I hope that you will keep up the fight and that others will take a part.

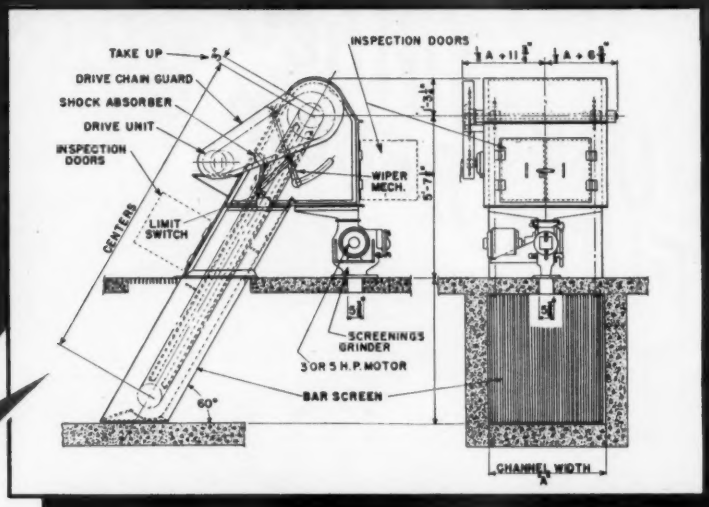
Your editorial on "Inactive Duty Training" reminds me of an instance at Carlisle. Some of us could see no reason for engineers sitting through classes in field surgery, so we went to ask the (medical) colonel in charge to let us arrange for lectures on sanitary engineering or malaria control problems. We were stopped by the executive officer (medical), locally called "Major Brush-off." He listened not very patiently, and dismissed us with the statement that the courses were arranged with due consideration to all concerned and would not be changed.

I have tried to get transferred to another service, but was not able to do so and so would not accept a reserve commission (in the Medical Service Corps). If you could suggest any solution and action that we could

(Continued on page 32)

THEY WORK TOGETHER...

MECHANICALLY CLEANED BAR SCREEN WITH SCREENINGS GRINDER

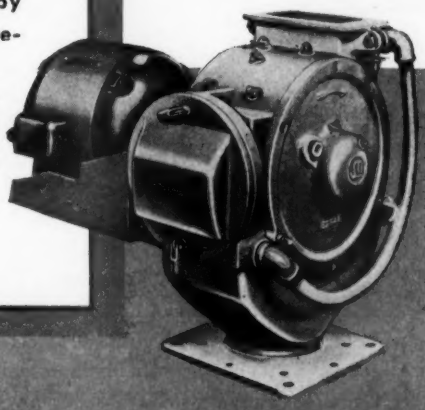


Efficient apparatus for the removal of coarse suspended matter and disposal is this Jeffrey Screen and Grinder combination. It takes care of the final disposal of screenings so important in the treatment of sewage. Screenings collected and disposed of by grinding them to a pulp and returning them to the sewage. This combination is designed for moderate-size treatment plants. We will be glad to go into detail.

Above—Dimension drawing of screen with screenings grinder arranged for hand feeding of screenings.

Automatically cleaned Bar Screen for moderate-size treatment plants. Can be furnished in widths and lengths to suit requirements. Unit shipped factory assembled.

(Patented)



The new Jeffrey streamlined grinder (S-126-A). Swing hammer design with cutting elements of hardened steel mounted on rotor pins. Provided with metal catcher. (Pat. and Pats. Pending).

JEFFREY

ESTABLISHED 1877

THE JEFFREY MANUFACTURING COMPANY, 947-99 North Fourth St., Columbus 16, Ohio

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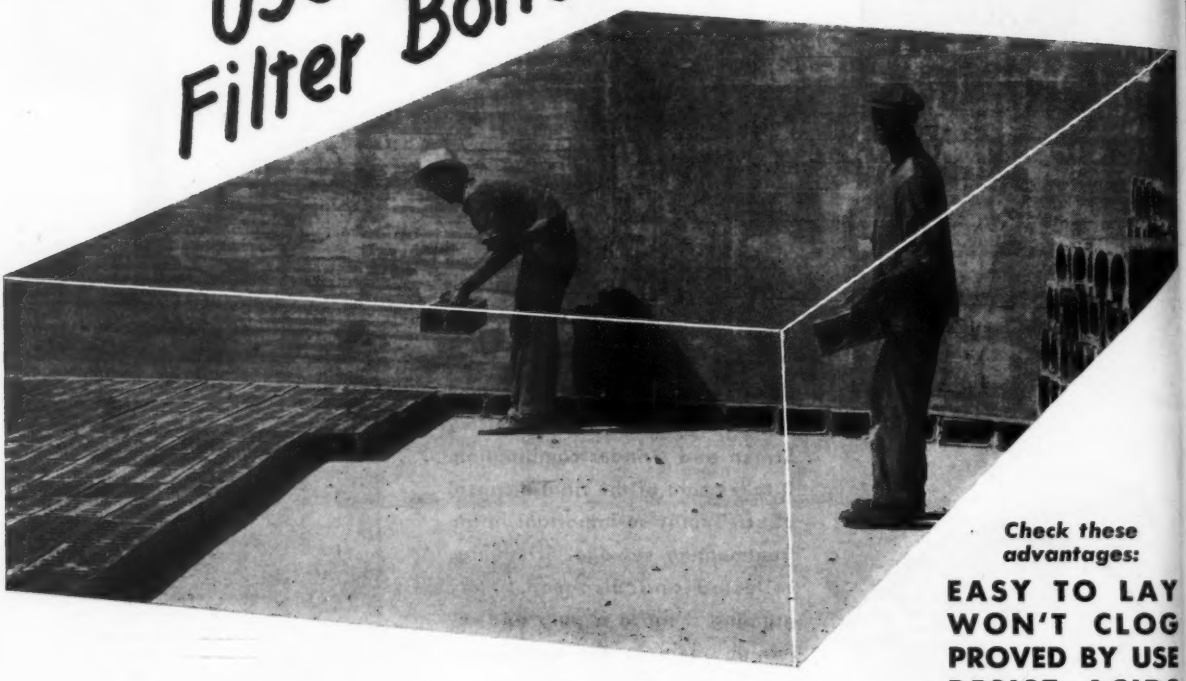
For Better Results From Trickling Filters

Use Vitrified Clay Filter Bottom Blocks



Check these advantages:

EASY TO LAY
WON'T CLOG
PROVED BY USE
RESIST ACIDS

Super-Smooth, Non-Clogging Channels Save Trouble Later. Solids cannot cling to the mirror-smooth channels in the *Vitrified Clay Filter Bottom Blocks* made by members of the Trickling Filter Floor Institute. Each block is salt-glazed with the entire inner surface super-smooth to give the finest operating results. Large openings in the tops allow air to circulate freely while carrying the sewage out. They help maintain aerobic conditions at all times. They are easy to lay, too, even with unskilled labor. They are self-aligning and easy to work on after laying.

These specially designed, finest quality blocks are made with standard fittings for use in any type or shape trickling filter. Write any of these members of the Trickling Filter Floor Institute for latest engineering data, prices, etc. Ask for new Trickling Filter Handbook, too.

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AYER-McCAREL-REAGAN CLAY CO., Brazil, Ind.
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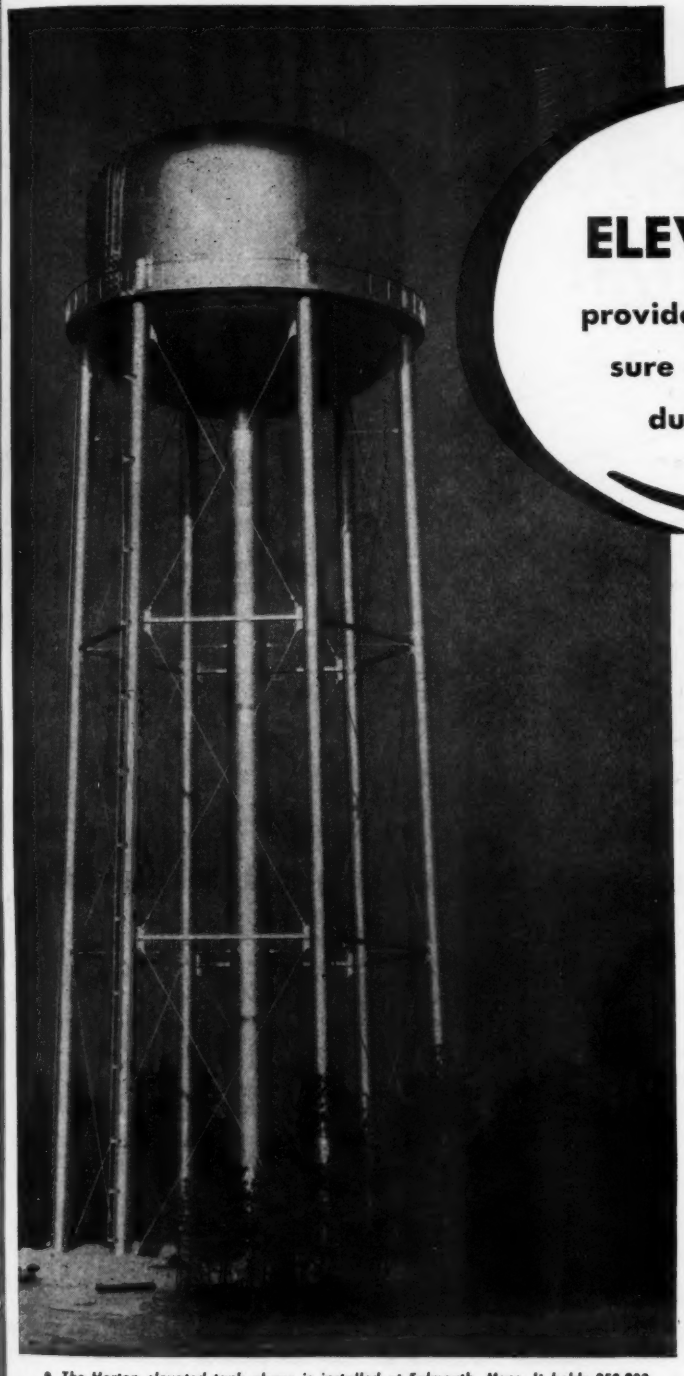
When you need special information—consult the **ENGINEERS' LIBRARY** *on pages 77-80*



HORTON ELEVATED TANK

provides efficient gravity pressure to meet peak demands during summer months

• *The Horton elevated tank above is installed at Falmouth, Mass. It holds 250,000 gals. and is 111 ft. to bottom. Tanks of this type have a relatively large diameter and shallow depth which reduces the variation in pressure between the upper and lower water levels.*

The town of Falmouth, Massachusetts, is proud of its attractive Horton elevated water tank shown at the left. It is also proud of its water supply system, which is unusual in that it consists of about 120 miles of mains to supply approximately 3,300 consumers. A popular vacation area, the daily usage of water in the town of Falmouth approaches 3 mgd during the peak of the summer season. But from October 1 to April 1, there are only about 1,600 water users.

The main source of supply is a fresh-water lake in the westerly section of the area served. An auxiliary source from shallow driven wells is located near the east side of the system. A steam pumping station, with gasoline engine-driven standby pumps, operates the year 'round, while the auxiliary wells serve during peak requirements.

The elevated tank is located near the eastern edge of the system, about 4½ miles from the pumping station. Prior to its erection, a deficiency in pressure existed in this area at hours of peak demand, and fire protection was inadequate. It is expected that the elevated tank will maintain satisfactory pressure at all times, and substantially improve fire flow. The system also has approximately one million gallons in standpipes located along the western side of the distribution system.

HORTON

STEEL STORAGE TANKS
...for municipal service

CHICAGO BRIDGE & IRON COMPANY

Plants in Birmingham, Chicago, Salt Lake City, and Greenville, Pa.

Chicago 4 . . . . . 2115 McCormick Bldg.
New York 6 . . . 3316-165 Broadway Bldg.
Cleveland 15 . . . . 2221 Guildhall Bldg.
Birmingham 1 . . . . 1532 North Fiftieth St.
Tulsa 3 . . . . . 1641 Hunt Bldg.
Houston 2 . . . 2142 National Standard Bldg.
Detroit 26 . . . . . 1536 Lafayette Bldg.
Philadelphia 3, 1648-1700 Walnut Street Bldg.
San Francisco 11, 1255-22 Battery Street Bldg.
Los Angeles 14 . . . 1408 Wm. Fox Bldg.
Atlanta 3 . . . . . 2123 Healey Bldg.
Havana . . . . . 402 Abreu Bldg.

When you need special information—consult the **ENGINEERS' LIBRARY** *on pages 77-80*

Le Roi Announces the 31 Clay Digger

— with new design features that reduce both digging and upkeep costs

Here's a digger that has everything you want. Just take a look at all these design advantages:

● **Short 19-inch length** — is responsible for the fine easy-handling balance of the new 31 clay digger.

● **It weighs only 18 pounds** — A man does more work with the new Le Roi 31, and uses less effort.

● **Exclusive new buffer design saves time and money** — This new buffer consists of molded rubber bonded to hardened split steel rings. There is only one piece to handle. Changing tools requires just a few seconds and no effort at all. Your operator does more digging.

● **Air consumption is low, efficiency high** — The 31's new trouble-free valve design uses air sparingly. The high efficiency — that is, the 31's ability to produce a lot of work — is made possible by a unique arrangement of valve-chest differentials.

● **Only the 31 has an integrally-built lubrication system** — Oil from a large reservoir in the handle is metered into the live air stream and carried to every working part.

● **The 31 is sealed from dirt and grit** — the new rubber buffer keeps destructive foreign matter out of the digger.

● **Cylinder life is greatly increased by the use of renewable spacer and chuck bushings** — Moreover, the handle, cylinder, and retainer are made from sturdy drop forgings. That is why Le Roi 31's serve you efficiently for years.

Give your men a clay digger that they like to use — give them a digger that makes them more productive — give them Le Roi 31's.

Your nearby Le Roi distributor can show you how the 31 Clay Digger design pays off in lower costs. Write us for specifications and latest literature.

LE ROI COMPANY

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RD-16

Le Roi 31 Clay Diggers give you a good opportunity to reduce your digging costs

When you need special information—consult the **ENGINEERS' LIBRARY** *on pages 77-80*

"Varec" THE GUARDIAN OF SEWAGE GAS CONTROL

THE PACE SETTER SINCE 1928

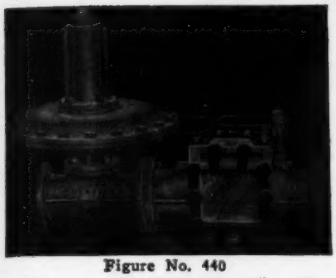


Figure No. 440

Sizes	2"	2½"	3"	4"	6"
Sh. wt.	125	140	160	200	260

← THE NEW "VAREC" *Approved* PRESSURE RELIEF AND FLAME TRAP ASSEMBLY

Unit consists of Diaphragm-operated Regulator. Flame Trap, and Thermal Shutoff Valve. Maintains a predetermined back pressure, passing surplus gas to Burner. Stops flame propagation. Patented telescopic flame trap element simplifies inspection and maintenance. Listed by the Underwriters' Laboratories for vent lines in oil tanks.

Figure No. 58C

"VAREC" *Approved* PRESSURE RELIEF AND VACUUM BREAKER VALVE WITH ← FLAME ARRESTER

Installed on digesters and gas holder domes, it affords emergency Pressure and Vacuum Relief and prevents flame entrance from atmospheric disturbances. Equipped with extensible Flame Arresting element for easy inspection and maintenance. Pure aluminum. Non-corrosive. Listed by the Underwriters' Laboratories for Vent Lines in oil tanks. Size 2" to 10".

Sizes	2"	3"	4"	6"
Sh. wt.	70	105	160	225

"VAREC" *Approved* WASTE GAS BURNERS →

Installed wherever disposal of surplus gas is a problem. Unit has adjustable air intake in the venturi tube, pilot valve adjustable from outside. Long, heavy cast iron draft stack insures proper draft and complete combustion.

Sizes	2"	3"	4"
Sh. wt.	450	480	500

Figure No. 236

Figure No. 450

"VAREC" *Approved* FLAME TRAP ASSEMBLY

Flame Trap and Thermal Shutoff Valve Unit self-contained, simple, foolproof. Installed in all gas lines supplying gas utilization equipment. No expensive fitting-up necessary. Arrests flame propagation. Easy inspection and maintenance. Aluminum and stainless steel. Non-corrosive. Flame Trap Element listed by Underwriters' Laboratories for vent lines in oil tanks.

Sizes	2"	2½"	3"	4"	6"
Sh. wt.	90	100	115	150	200

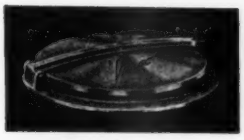


Figure No. 220A

"VAREC" *Approved* MANHOLE COVERS

Installed on digester and gas holder dome, affords quick and easy access. Has square, graphite-impregnated, fire proof gasket. Non-sparking. Gas-tight.

Sizes	18"	20"
Sh. wt.	100	110

Figure No. 51A

"VAREC" *Approved* FLAME CHECK

Acid resisting Union type fitting. Positive flame stop for small lines. Has five 40-mesh fire screens. Easy inspection and maintenance.

Sizes	½"	¾"	1"
Sh. wt.	10	10	10

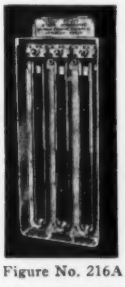


Figure No. 216A

"VAREC" *Approved* MANOMETERS

Single or Triple tube. Open or push-button control types. Accurate. Aluminum housing. Bronze fittings. Pyrex glass. Automatic—Fireproof—Safe. Sizes 6" to 36".

Sizes	9"	12"	15"
Sh. wt.	16	18	20

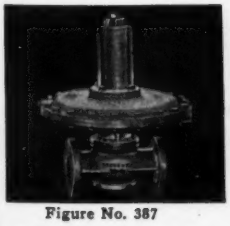


Figure No. 387

"VAREC" *Approved* SENSITIVE PRESSURE (REDUCING) REGULATOR SINGLE PORT

Maintains upstream or downstream pressure to within 0.5" of water of pre-determined pressure. Positive Shutoff. Aluminum body. Throttling type inner valve. 18-8 stainless steel trim. Sizes 2" to 6".

Sizes	2"	2½"	3"	4"
Sh. wt.	110	115	140	175

Figure No. 211A

"VAREC" *Approved* BACK PRESSURE (REDUCING) CHECK VALVE

Installed in relatively low pressure gas lines. Prevents back flow through meters. Non-shattering, non-pulsating, non-corrosive, non-sparking.

2"	3"	4"	6"
20	35	70	125

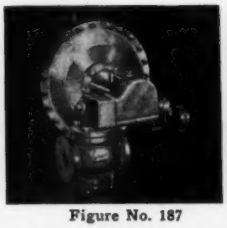


Figure No. 187

"VAREC" *Approved* SUPER SENSITIVE PRESSURE (REDUCING) REGULATOR DOUBLE PORT

Maintains upstream or downstream pressure to within 0.2" of water of pre-determined pressure. Standard working parts 18-8 stainless steel with synthetic rubber diaphragm. Non-corrosive. Sizes ½" to 10".

2"	2½"	3"	4"	6"
190	200	233	260	350

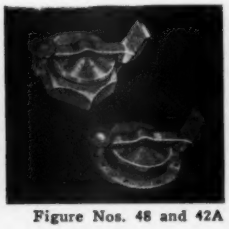


Figure Nos. 48 and 42A

"VAREC" *Approved* SAMPLING HATCH COVERS

For use on digester domes. Available in several combinations of materials. Non-corrosive, gas-tight, self-closing, spark-proof. Figure 42A Flanged and Figure 48 Screwed.

4"	6"	8"	10"
12	17	23	27

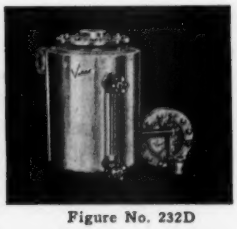


Figure No. 232D

"VAREC" *Approved* SEDIMENT TRAP AND CONDENSATE DRIP TRAP ASSEMBLY

Cast iron construction. 18-8 stainless steel working parts. Hand operated or automatic. Sizes 2"-2½"-3"-4".

THE VAPOR RECOVERY SYSTEMS COMPANY

COMPTON • CALIFORNIA • U.S.A. — Cable Address VAREC COMPTON (All Codes)
NEW YORK CITY — CHICAGO, ILL. — TULSA, OKLA. — HOUSTON, TEX. — CLEVELAND, OHIO
Agencies Everywhere

Send for "Varec" Catalog S-3 for complete Sewage Gas Control Equipment.

When writing, we will appreciate your mentioning PUBLIC WORKS

HERE'S A "PACKAGE" TREATMENT PLANT *that fits a modest budget*

MODERATE FIRST COST, HIGH DEGREE OF PURIFICATION AND EXCEPTIONALLY LOW OPERATING COST MAKE THIS DEPENDABLE UNIT IDEAL FOR SMALL COMMUNITIES UP TO 3500 PERSONS AND FOR ISOLATED PLANTS AND INSTITUTIONS

Many small communities and outlying plants, compelled on the one hand to purify wastes in order to stop pollution, but lacking ample supply of diluting water, have solved their seemingly insoluble difficulty by means of the Yeomans "Package" Aerifier activated sludge plant.

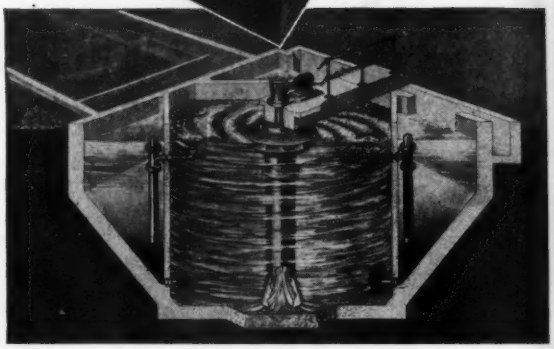
HIGH EFFICIENCY AT LOW COST

Here indeed is a highly efficient means of purification designed to fit the modest budget. In a single compact concrete unit of minimum dimensions you get aeration and final sedimentation; producing crystal-clear effluent at remarkably low over-all plant cost. Because there are no odors or flies, the plant can be located near habitation. Operation is simple, with supervision limited to routine check-up. All units are open for visual inspection. With its permanent concrete construction it is a plant that will perform efficiently for many years. .

GOOD ENGINEERING

Each installation of the Yeomans Aerifier includes final adjustment, initial tested operation, thorough training of operators and continued counsel from an organization with a 50-year reputation for good engineering.

A Yeomans recommendation, based on data covering your needs, complete with construction cost estimates and application engineering, will be sent upon request.



Basic element of the "Aerifier" is the Yeomans "Spiralflo" mechanical aerator. Its essential parts are:

- **a stationary up-draft tube**
- **a rotating aeration cone**
- **an electrical and mechanical drive unit to rotate the cone**

By rotation of the cone, liquor is drawn up through the tube and thrown out in spiral waves—entraining air bubbles to permeate the entire content of the tank with oxygen. The tank content rotates gently, to preserve the floc and promote flocculation. Aeration is complete. There is no deposit of activated sludge on the tank bottom. Power consumption is low.

Other "Aerifier" parts are adjustable loading funnels, angular corner clarifier compartments, automatic return for activated sludge to the aeration tank, and automatic return of excess activated sludge to the primary tank.

These bulletins will be found most helpful—write for them:

"Spiralflo" Aerator—a full description of this simple, highly efficient unit. **Bulletin 6601**

"Aerifier"—for activated sludge plants—a complete explanation of design, construction and operation principle. **Bulletin 6651**

YEOMANS BROTHERS COMPANY, 1425 NORTH DAYTON STREET, CHICAGO 22, ILLINOIS

FOR HANDLING AND TREATMENT OF DOMESTIC SEWAGE AND INDUSTRIAL WASTE, YEOMANS MANUFACTURES

Yeomans Aero-Filter—high capacity trickling filter process • Yeomans "Package" Aerifier—activated sludge process • Rectangular and Circular Sludge Collectors • Digesters • Centrifugal and Pneumatic Sewage Ejectors • Scum, Grease and Sludge Pneumatic Ejectors • Rotary Distributors • Plunger Sludge Pumps

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50 YEARS OF PUMP EXPERIENCE

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PUBLIC WORKS MAGAZINE . . . May, 1948

VOL. 79. NO. 5

Vertical Sand Drains for Supporting Embankments Over Marshes

THOMAS E. STANTON

Materials and Research Engineer, California Division of Highways

SINCE 1936 the California Division of Highways has used vertical sand drains, totaling 1,108,807 lineal feet of drains, on 22 projects which necessitated placing embankment on marshy land. The method consists of constructing 18″ to 24″ sand-filled vertical drains spaced approximately 10 ft. centers, and placing on the ground surface, and in contact with the sand in the drains, a layer of sand 12″ thick covering the entire area to the outer slopes of the embankment. This provides a short horizontal flow distance for the contained water from the saturated soil to the vertical drains, the water squeezed out of the soil by the weight of the embankment rising through these and passing horizontally through the sand layer to the face of the embankment.

It has been conclusively demonstrated by California's experience that plastic foundations can be stabilized economically and embankment settlement accelerated materially by this method. Its success depends on the proper selection of the size and spacing of the drains, the nature of the sand backfill and superimposed sand blanket, and the rate of application of the embankment load. The settlement during construction is usually such that there is very little subsequent settlement. The consolidation of the saturated foundation soil rather than its displacement by the weight of the embankment reduces the amount of fill needed, thus partially offsetting the cost of the sand drain.

Preliminary Steps

Thorough preliminary investigation is necessary. Borings are made to determine depth to solid material. Undisturbed samples are obtained for such laboratory tests as moisture content, density, grain size, consolidation, cohesive strength, and angle of internal friction. From these data are determined the required spacing and depth of the vertical drains for the design height of fill and anticipated ultimate settlement.

As the ground is frequently too soft to support the construction equipment, it is necessary first to place on it a blanket of suitable material to provide a "working platform."

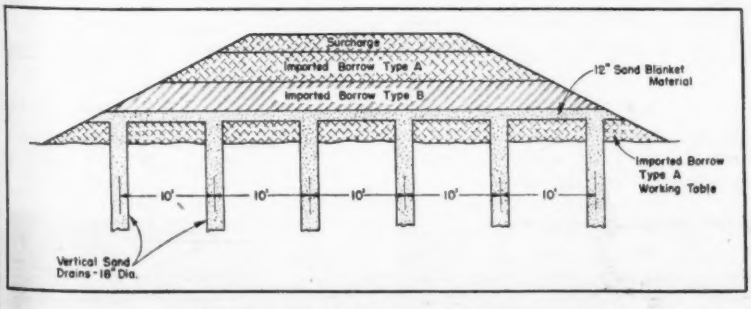
Constructing the Drains

Five methods have been used in California for constructing these vertical drains: Rotary drill, rotary jet, driven mandrel, and jetted mandrel of the double wall and of the closed end types. The rotary drill was used on all but four of the 14 jobs between 1934 and 1944, for depths up to 76 ft., two of the others being by driven mandrel and two by rotary jet. Since then all have been by mandrel, 5 driven and 3 jetted.

The rotary drill method uses a rotary drill rig operating a bucket which has cutting blades on the bottom. The rotary jet consists of cutting blades and jets of water to wash the cuttings to the surface. In the driven mandrel method a hollow steel mandrel with a hinged bottom plate is driven to the desired depth, filled with sand, and withdrawn, the hinged bottom plate opening and allowing the sand to flow into the hole. In some cases compressed air is applied into the mandrel to force out the sand. Under some conditions, where none of the other methods seemed feasible or economical, a jetted mandrel has been used, consisting of a 16″ pipe inside of a 19″ pipe, water and compressed air being forced either through the annular space between the pipes (double wall type) or through the central pipe (closed end type) emerging through jets in the bottom plate, which jets loosen the

(Continued on page 32)

Driving a mandrel.



Typical section of drains and embankment.

Richmond-Sunset Sewage Treatment Plant Operation

THE beaches along the north shore of San Francisco are among the main recreational areas of the city. Previous to the construction of the Richmond-Sunset sewage treatment plant these beach waters were grossly polluted, as shown by tests made by the Department of Public Health and by physical deposits on the shores. Since the Richmond-Sunset Plant has been in operation these conditions have been materially improved to the extent that these waters now conform to the bacteriological standards set by the State Department of Public Health and there are no physical evidences of sewage pollution.

The plant treats the sewage from the Richmond and Sunset Districts, the residential areas of the western slope of the City, comprising an area of 6,825 acres, with a contributing population of approximately 205,000 people. Floating matter, grease and oil, grit, and practically all of the settleable solids are removed in the plant, and the effluent is chlorinated for bacterial disinfection before being discharged into the ocean at Mile Rock Outfall. Of the material removed from the sewage, the sludge is subjected to biological digestion. the screenings are incinerated and the grit is hauled to a dump for disposal. The digested sludge is elutriated, dewatered on a vacuum filter, and the filter cake produced is delivered to the Park Department for use as fertilizer.

Plant Enlargements

Funds for construction to increase plant capacity to the design flow of 15 million gallons per day became available in the 1944 Sewer Bond Issue. On June 26, 1946, two contracts were awarded for the enlargement — a structural contract for $523,900 to Clinton Construction Company, and a mechanical and electrical contract for $276,297 to Anderson & Rowe.

The principal features of the enlargement contracts are:

Construction of new 100-ft. diameter pre-stressed concrete primary digester; conversion of existing 80-ft. diameter digester from primary to secondary, with installation of floating cover, and construction of digester operating house.

Construction of two additional mixing and sedimentation tanks with necessary mechanical equipment; removal of existing wooden superstructure and construction of new reinforced concrete structure over existing and new tanks, including ventilating equipment, etc. Remodeling of existing sludge control house to increase capacity of thickening tanks and installation of additional sludge pumps; installation of additional chlorinator and electric evaporators; new sand pump; relocation of existing scum removal equipment; installation of additional vacuum filter and appurtenances; additions to elutriation system; and other revisions.

With the completion of the enlargements the plant will have sufficient capacity to handle adequately the ultimate flow from the tributary districts.

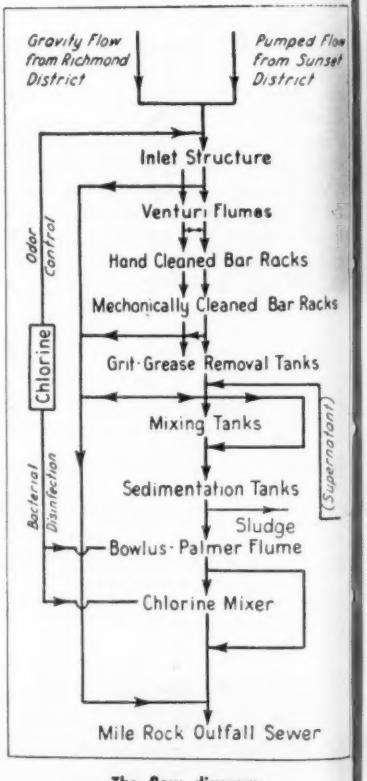
The total quantity of sewage treated during the year was 3,418.6 million gallons, of which 1,645.2 million gallons flowed to the plant by gravity from the Richmond District, and the balance, 1,773.4 million gallons from the Sunset District, was pumped to the plant inlet by the Sunset pumping plant. The total flow treated increased 195.2 million gallons over the preceding year. The average daily flow for the year was 10.5 million gallons for the actual time of plant operation, an increase of 2% over the previous year.

Pre-Treatment

The bar racks were operated continuously throughout the year. Approximately 1.25 cubic feet of screening were removed per million gallons of sewage treated.

Four grit-grease tanks were constructed in the original contract for the plant, two of which had mechanical equipment. The contract for the installation of the additional equipment was completed in May, 1947, and the tanks placed in service. With this additional capacity more grit will be removed, thereby lessening the amount depositing in the mixing tanks ahead of the sedimentation tanks. A total of 657 cubic yards of sand was removed from the grit-grease tanks, washed and hauled to a dump. In addition, 299,200 gallons of grease were pumped to the thickening tanks in the Sludge Control House. Additional grease is removed from the inlet channel to the mixing and sedimentation tanks and from the sedimentation tanks. A further benefit of the grit-grease tanks is the addition of oxygen to the sewage.

The raw sewage was pre-chlorinated continuously for odor control at the rate of 30 pounds of chlorine per mg. The plant effluent was chlorinated for disinfection, except during storms or when by-passing the Sunset flow, at a variable rate from 80 to 100 pounds per million gallons to maintain an average residual of 0.5 ppm after a contact period of five minutes. Approximately 103,000 pounds of chlorine were used for pre-chlorination and approximately 201,000 pounds for post-chlorination. Post-chlorination was very effective



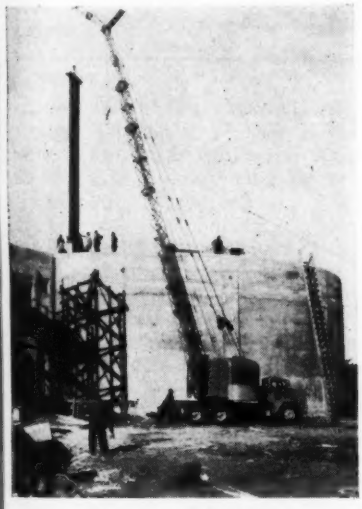
The flow diagram.

in destroying bacteria, and during the time it was used for the coliform index of the plant effluent was on the average less than 10 organisms per milliliter, the limit set by the State Department of Public Health for beach waters.

Sludge Control and Sedimentation

The sewage after pre-treatment and chlorination is flocculated in mixing tanks (design holding capacity 30 minutes) and then settled in sedimentation tanks (design holding capacity 90 minutes). During the year, with flows averaging 140% of design capacity, removals of suspended solids averaged 69% for normal operation and 65% for the year, including two months affected by construction. The corresponding removals of 5-day BOD were 51% and 45%, respectively. The raw sewage averaged 240 ppm suspended solids and 265 ppm 5-day BOD.

The sludge from the sedimentation tanks flows by gravity to sludge

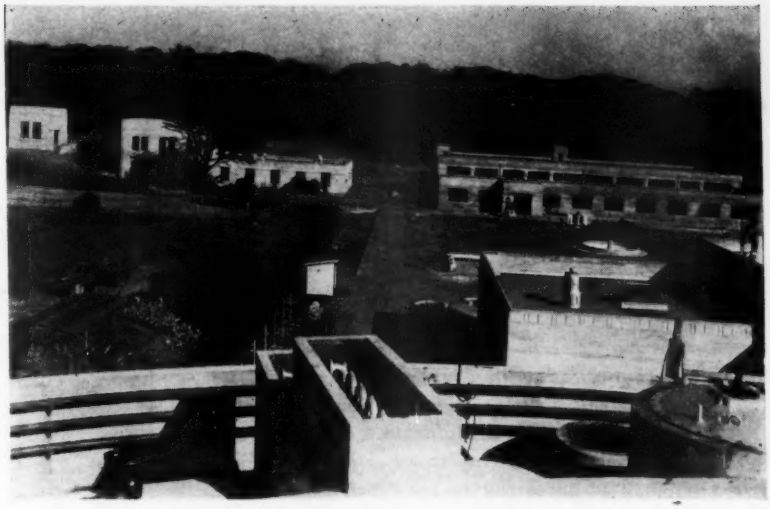


Installing a heat exchanger.

thickening tanks through sight feeds to allow the operator to control withdrawals. After thickening, the sludge, plus the grease removed from other units, is pumped to the digester and the supernatant is returned to the inlet channel to the sedimentation tanks. For the year, 17,500,000 gallons of raw sludge averaging 4.43% solids, or 6,500,000 pounds of dry solids, were pumped to the digester. This sludge averaged 83.9% volatile.

Sludge Digestion

The single 80-ft. diameter digester handled the digestion of the raw sludge as effectively as could be expected with the limited capacity



A view of a part of the treatment plant grounds.

available. It was possible to reduce the average volatile matter by digestion from 83.9% to 65.8%, which, together with the reduction in total solids, gave a net reduction in volatile matter of 63.1%. Approximately 6,500,000 pounds of dry solids were pumped to the digester and 2,549,000 pounds of dry solids were removed during the year.

The seeding pump re-circulated bottom sludge to the top of the scum layer continuously, except during pumping of raw sludge to the digester when the seeded sludge was mixed with the incoming raw sludge. At times the digester contents were fairly uniform throughout and at other times the supernatant below the scum layer was relatively clear. This depended upon the total solids added to the digester. The withdrawal from the digester was regulated to correspond approximately to an equivalent amount of raw sludge added.

Gas production continued quite uniformly throughout the year; leakage of gas through the digester seals was at a minimum. During dry weather months metered gas production averaged 150,000 cubic feet per day, or approximately 0.8 cubic feet per day per capita of connected population. Approximately one-half of the gas produced was utilized in the boilers for heating water circulating through the digester heating coils and for hot water for plant purposes. The balance of the gas was burned at the waste gas burner.

The temperature of the digester varied from 82 to 90°F. It was not possible to maintain uniformly high temperatures due to leaks in the heating coils and scale deposition on the coils. This condition will be corrected in the primary digester now being constructed by provision for removal of individual coils for necessary maintenance.

Elutriation and Sludge Filtration

All sludge withdrawn from the digester was washed in the elutriation tanks, using counter-current flow. Plant effluent was used as wash water in the ratio of approximately three volumes to one volume of sludge. Elutriation reduced the alkalinity of the digested sludge from an average of 1860 ppm as calcium carbonate to 380 ppm as calcium carbonate, a reduction of 80%.

The vacuum filter operated regularly throughout the year. The required average amount of ferric chloride based on dry solids was 4.27%. An average life of 1,000 hours has been obtained with the wool filter cloths. After this period blind spots appear and the percentage of ferric chloride required for filtration increases. Deposits of iron oxide on the filter screen were removed when the cloths were replaced by rotating the drum for about eight hours in an approximately 20 per cent hydrochloric acid solution inhibited with aniline oil. For the year approximately 8,000,000 pounds of filter cake of 75.1% moisture content, corresponding to 5500 cubic yards, were produced. This cake was hauled by plant personnel to City parks for use as fertilizer.

The source of this article is the excellent report of the Bureau of Public Works of the City and County of San Francisco for the fiscal year ending June 30, 1947. The illustrations were furnished through the courtesy of Ralph G. Wadsworth, City engineer.

Dams in PERMAFROST

By JOSEPH D. LEWIN

The first two articles in this series discussed the basic factors in connection with foundation design in very cold climates. This article begins a discussion of the design and construction of dams in areas where the ground is permanently frozen. Particular difficulty arises when it is necessary to construct dams on fine, silty soils, as these may be thawed by the heat of the water in the reservoir and failure may occur. Ice cover is important; and so are adequate provisions for reducing the damage due to ice thrust.

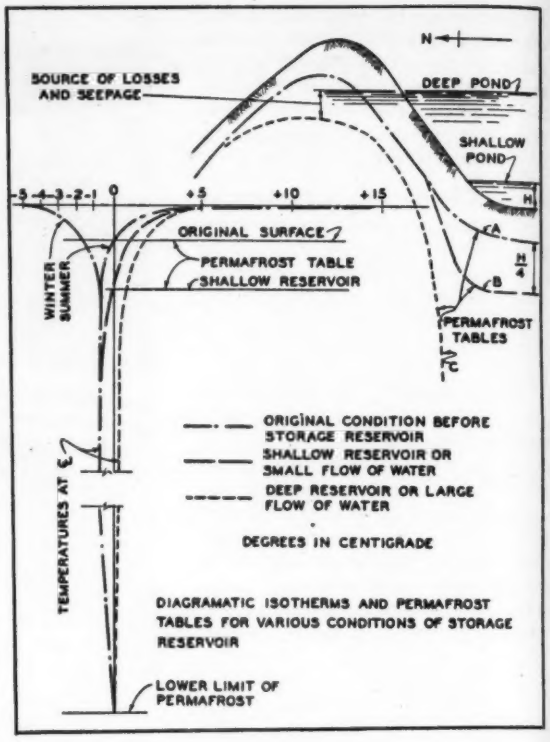


Fig. 1 →

FORMATION of an ice layer on a stream or reservoir, as well as the thickness of the ice layer resulting from cold weather, follows a progression that can be evaluated reasonably well. Basic assumptions are that the water temperature remains constant, the temperature of the ground under the water is not lower than the water temperature, and the body of water loses heat to the atmosphere. The temperature gradient in the ice is not linear, and the application of calculus is necessary if an exact analysis is desired. Both empirical and analytical formula are used in such determinations; in general, the theoretical equations are suitable for determining ice thickness in still water reservoirs; however, in flowing water, empirical equations, based on the work of Devik[2] and Bydin[3], appear to be more useful.

For arctic conditions, assuming the worst climatic situation, with a minimum rate of flow of water and no snow cover, the maximum ice thickness has been computed by Weyprecht[7] as 2.37 meters or 7.8 ft. Taking into account all of the factors of importance, including the freezing effect of permafrost on the body of water above it, the writer suggests using a figure of about 12 ft., maximum. This should be ample to provide for any conditions in the arctic zone.

This ice thickness is important in two respects—it establishes the minimum depth of the reservoir, and it is also a basis for determining the potential ice pressure on the impounding structure. The latter subject has been discussed quite fully by Rose[5] and is therefore omitted here.

Effect of Storage Reservoir on Permafrost

The body of unfrozen water contains sufficient heat to thaw the permafrost, and this may be a matter of primary importance. The water will thaw not only the underlying permafrost, but also embankments immediately adjacent to the shores of the reservoir. If such embankments contain large masses of ground ice, serious subsidence will occur, in some cases resulting in slides or cave-ins. Furthermore, it is necessary to ascertain whether the area to be flooded by the future reservoir is on islands of permafrost and taliks which extend into adjacent valleys. Any inclusions of ice layers under such conditions must be carefully investigated.

The thermal equilibrium between the reservoir and permafrost can be evaluated quite closely. It is known that the amount of available heat contained in a body of water is the product of the specific heat of the water, the volume or weight of the water, and the difference between the initial and final water temperatures. If the initial water temperature is assumed to be 39°F and the final temperature 32°F, each cubic foot of water contains 62.5 x 7, or 437.5 btu. The heat required to defrost the ground can also be computed. Assuming a cubic foot of dry sand weighs 105 pounds, that the void ratio is 50%, that ice fills 80% of the voids, that the weight of ice is 56.25 lbs. per cubic foot, that the temperature of the frozen soil is 31°F and of the thawed soil is 32.5°F, the computations will be as follows: The weight of the ice in a cubic foot of the soil is 0.40 x 56.25, or 22.5 pounds; the heat required to raise the ice temperature from 31°F to 32°F is 0.487 btu. per pound, or 22.5 x 0.487, a total of 10 btu. To melt the ice 144 btu. are required per pound, or a total of 3,240 btu. To raise the resulting water temperature from 32°F to 32.5°F, requires 11 btu. To raise the soil temperature from 31°F to 32.5°F (specific heat 0.195) requires 0.195 x 105 lbs. x 1.5, or 31 btu. The total heat requirements are therefore 3,292 btu. There is a small overlapping here, since it is assumed that the water is cooled to 32°F, while the soil is heated to 32.5°F. It is difficult to obtain an exact balance, however, and round figures, as 3,300 btu. for the above requirements, should be used.

Since the heat liberated from the water must be equal to the heat re-

quired for defrosting the soil, it is obvious that for the conditions assumed in these calculations, it is necessary to have a water depth of 3,300 ÷ 437.5, or about 7.5 ft. for each foot of defrosted permafrost. This holds true only if there is no inflow of water into the reservoir; but for any flow condition, a heat balance can be obtained. It must be remembered that the greater the quantity of ice in the permafrost, the less will be the effective thawing depth of the body of water.

For normal conditions of water supply reservoirs, the writer suggests for safe estimating purposes, a defrosting depth of one-fourth of the water depth. Thus, for a reservoir 100 feet deep, the permafrost may be defrosted to a depth of 25 ft.

Similarly, the defrosting action upon the embankments can be evaluated. The conditions are shown diagrammatically in Fig. 1. For purposes of clarity, the dimensions have been exaggerated. Line A represents the initial permafrost table before water is impounded. If a shallow pool is created (depth H), the permafrost table will recede to line B. However, if the flow of water is large or if the temperature of the water in the reservoir is high, the permafrost table may disappear completely, as shown by line C. The ground temperatures curves, shown at the left of Fig. 1, clarify the recession of the permafrost table. The complete disappearance of the permafrost table under large bodies of water has been confirmed by Stepanenko[6] and other Russian investigators.

Effect of Earth Fill on Permafrost

Earth fill placed on permafrost forms a protective insulation against the climatic effects, and tends, therefore, to raise the permafrost table. This effect has been observed under highway and railroad fills, as well as under gravel mats for foundations of structures, airfield runways, and the like. Numerical evaluation of the thermal conditions existing under earth fills has been elaborated by Sukhodolsky[7]. Fig. 2 shows the pattern of relocation of the permafrost table (line B) due to an earth fill.

COMPUTATIONS FOR ICE THICKNESS

The thickness of ice can be computed, for still water, with no snow cover, and neglecting the temperature gradient through the ice, by the formula:

$$L^2 = \frac{2k\,(\Theta_w - \Theta_a)\,t}{w_i\,f_i} \qquad (1)$$

where $k = 1.26$, the coefficient of thermal conductivity of ice; Θ_w is the temperature of the water in degrees F, assumed here as 33°; Θ_a is the average air temperature for the period under consideration; $f_i = 144$ btu per lb.; w_i is the weight of ice or 56.25 lbs. per cu. ft.; and L is the thickness of the ice in feet for t, the time under consideration, in hours.

Example. — Assuming an average air temperature of —7°F, then $\Theta_w - \Theta_a = 33 - (-7$, or 40; $w_i f_i = 144 \times 56.25$, or 8100. $L^2 = (2 \times 1.26 \times 40 \div 8100)t$; $L = 0.13\sqrt{t}$. If t is 150 days or 3,600 hours, then L is 0.13 x 60, or 7.8 ft.

To correct for the non-linear heat gradient through ice, the results obtained by formula (1) are multiplied by:

$$\sqrt{\frac{1}{1 + \frac{C_w \Theta_i}{3\,f_i}}} \qquad (2)$$

where C_w is 1.0; Θ_i is the difference between the surface temperature of the ice (that is the air temperature) and the water temperature; and f_i is 144.

Example.—For —7°F, the temperature differential is 39°. Substituting in formula (2) above, the factor is 0.957. Then 7.8, the thickness of ice obtained by formula (1), is multiplied by 0.957, and the thickness when corrected for temperature gradient will be 7.8 x 0.957, or 7.46 ft.

To correct for snow cover, using S, the depth of snow cover in inches, the results obtained by formula (1) are multiplied by:

$$\frac{1}{1 + 0.05S} \qquad (3)$$

For 10 ins. of snow cover, the correction will be 0.67; that is, 10 ins. of snow cover will reduce ice thickness approximately one-third. However, much depends on the type of snow. A hard, packed snow may reduce ice thickness only by its own depth.

To correct for velocity of flow, as in a reservoir, where V is the velocity of flow in feet per second, the following formula may be used for flows between 0.60 ft. per second and 1.70 ft. per second:

$$\frac{1}{1 + 0.3V^3} \qquad (4)$$

For a velocity of 1.66 feet per second, the reducing factor will be 0.89.

Thus the thickness of ice under the conditions assumed in formula (1), where there is 10 ins. of snow cover and a current velocity of 1.66 ft. (0.5 meter) per second, will be 7.46 x 0.67 x 0.89, or 4.42 ft.

The permafrost table is raised, if no water is stored. To account for the thawing effect of a body of water, the dam may be considered as the bank of the reservoir and the lowering of the permafrost table (line C) is computed by the method previously described. The author suggests, therefore, adoption of a method of successive determinations of the permafrost table in the body of the earth dam, rather than attempting to solve the problem simultaneously.

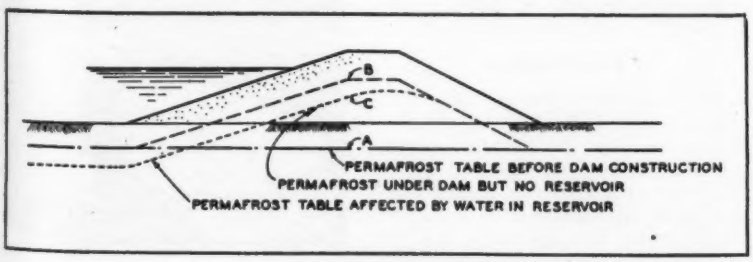


Fig. 2. Effects of fill on permafrost.

Dams on Permafrost

Because of the permafrost peculiarities of the sub-soil, the following criteria must be satisfied:

1) The dam must be flexible enough to sustain considerable subsidences due to thawing of the ground.
2) The dam must be composed of materials that will convey but little heat from the atmosphere to the ground.
3) The dam must be composed of such materials and be of sufficient thickness that it will not convey cold to the water in the reservoir.

(Continued on page 32)

Killing Weeds the Easy Way

Chemical weed control with 2,4D can mean a big saving of labor and expense. The author outlines spraying methods and classifies weeds according to susceptibility.

BART McDOWELL

THE old problem of controlling weeds in right-of-ways and parks is closer to a solution now than ever before. Recent research in the use of 2,4D—actually "2, 4 dichlorophenoxy-acetic acid"—will help keep weeds out of park lawns and vacant lots in cities and will combat the expensive threat of bushes and woody weeds on highway right-of-ways. Maintenance costs may be 30% to 50% below the older methods of hand and mechanical weed-killing, with man-hours reduced by 90%.

Equipment for Spraying

The low volume spray, which uses far less chemical, and the high volume spray have both been used for weed control. Because of its apparent economy, 2,4D has been tried with the low volume spray on a fairly large scale. This spray makes a very fine mist or fog of the solution, and because wind carries it easily, it can do a great deal of harm to shade trees and farm crops nearby. To control this drift, experiments have been made with "screens," such as canvas covers over the spray nozzles, but present use of the low volume spray is restricted to large parks. For narrow strips of weeds hand sprays may be cheaper to operate.

Woody weeds require a concentrated solution of the chemical. A standard, 200-gallon orchard sprayer is probably the best for this type of work. This sprayer can be mounted on a light truck or jeep for mobile work, or on wheel tractors. The best nozzle is probably the "pecan" type which can take pressures of 200 to 250 pounds. This permits reaching plants 35 to 40 feet away with enough force to be effective.

In the control of tree weeds, you will have the most success by using the ester type of 2,4D. This ester type is dissolved in an oil base and mixed in an emulsion of water. Use the equivalent of two pounds of 2,4D per acre. Although the amount may vary with the kind you use, you will need usually about three quarts of oil solution per 1000 gallons of water —with 125 gallons of the water emulsion per acre.

If you have a special problem of topography, you may prefer the boom sprayer with two or three flat atomizing spray nozzles at 16-inch intervals. With this type, you should use about 20 gallons of water emulsion per acre. Since this is low volume spraying, use it with great care.

The Right Time to Spray

The time of year and the weather greatly affect the use of 2,4D. Since this chemical reacts on the feeding system of plants, it is best to apply it when the plants are growing and feeding at the fastest rate. In general, the best time to kill woody weeds is between the first of June and frost. Try to catch your weeds before they are rank and big; some plants develop a strong resistance to this weed killer in the fall, and it's easier to kill any young plant than an older one. Another rule of thumb is this: Try to catch all brush-type weeds before they are six feet high. Larger ones may need an axe.

For top results, clear weather is best; even cloudy weather cuts down the speed of 2,4D. A check with the Weather Bureau will help. Although rain doesn't wash off the 2,4D, it certainly delays its action and may blunt its effect. Cool weather does, too. Wait until the weather is warm and plants are growing fast.

For the same reason, weeds growing in the shade may be a problem. They may take several treatments, when the same kind of weed in the sun would take only one. So don't expect the same results. But in treating shaded weeds, you may find that you have an ally in bacteria. Since 2,4D does not harm bacteria, some types of weeds may be rotted away faster than weeds in sunshine.

Special Problems

You may have some special problems that prevent spraying in the spring or early summer. For example, engineers of the Missouri State Highway Department wanted to kill bindweed, and chose to spray in the fall when its bloom makes it easy to locate although it is more resistant at that season. Also if your part of the country has a crab or quack grass problem, fall is better. Although 2,4D will not kill weed grasses, it is better to kill weeds when crab grass will not move into the bare spots. Crab grass grows very slowly in the fall, and most lawn grasses still grow vigorously then.

After you have treated your turf with 2,4D you should fertilize your grass. You should also reseed the bare areas so other weeds will not sprout in the bare areas. Here, it is better to use the water-base type of 2,4D, since you can reseed as soon as your 2,4D is dry. With the ester, or oil-base type, you should wait several weeks before reseeding.

The cost for controlling tree weeds is much less than for chopping down brush by hand or tearing them out mechanically. It has been estimated that the first application of 2,4D costs about $25 an acre. During the first six years, only three applications should be needed. By the third or fourth year, costs will drop to about $12.50 an acre. And after six years spraying should be necessary only every three or four years.

The Weeds You Can Kill and Those You Can't

For keeping down the fire hazard and nuisance of weeds in vacant lots, 2,4D is probably the most economical weed killer available. It also reduces the danger of using flame throwers, although it will not work as fast as fire. It has been used with good re-

How a hood is used to prevent damage to shrubs and flowers.

sults against ragweed and other pollen plants that plague hay-fever sufferers if used early in the season. You will find the standard hand-spray the most convenient to use in work like this, because it can be carried easily and will reach most weeds in lots. If weeds have grown rank, the ester type of 2,4D will be the best; if not, the water type.

Some lawn weeds are of course easier to kill than others. Plantain and dandelion, for example, are among the most common and the easiest to kill. Under the best of conditions, these weeds will take from two to four weeks to die. There will be no immediate change in their appearance, so be sure to give them time to die before you apply a second treatment. Wild onion is one of the harder lawn weeds to kill. The Department of Interior used 2,4D on its parks in Washington, D. C., against wild onion. They found it worked in early spring when the tops were growing fast; but in the fall, it was almost impossible to kill.

In treating lawns with 2,4D, it is necessary to be careful of shrubs and flowerbeds. If the weather is windy it may be best to wait, since the spray can drift and sometimes injure ornamental plants. At other times you may want to mask flowerbeds by covering them with canvas or paper, or you may prefer the canvas hood coverings to shield sprayers. Some flowers and shrubs are as resistant to2,4D as grasses, but it is always safer to take precautions. Here are some of the resistant plants: bridal wreath, golden elder, gladiolus, Irish juniper, regal lily, privet, Japanese yew, and violet. But these plants are exceptions; a good general rule is this: if the plant has a broad leaf, it is probably sensitive to 2,4D. There are of course, many plants that resist 2,4D. Among these are briars, although recent experiments with 2, 4, 5-trichlorophenoxy acetic acid seem to show some promise.

There are still other weed killers besides 2,4D that you should not forget. If you don't care about killing all vegetation, borax is good. For killing annual weeds in sidewalk cracks and similar places, ammate is the best. If you want to knock out all plants and the cost and soil fertility are not important, you can use sodium chlorate or atlacide, although they are inflammable. All these instant weed killers are more expensive than 2,4D, but they still have their uses.

Here are some plants grouped according to type and resistance to 2,4D.

Applying 2,4D with spray bars from a jeep, using a low-volume sprayer.

Woody Plants

Group 1—Susceptible.—All leaves and the current year's growth should be readily killed with 1½ to 2 pounds per acre. The entire plant can be killed with repeated treatments:

alder	honeysuckle
aspen	plum, wild
birch, black	sumacs
box elder	Virginia creeper
cherry, wild	walnut
cottonwood	tamarisk
elderberry	grape
hazel	

Group 2—Intermediate.—Use a heavier concentrate on these, up to 2½ pounds of acid per acre. They are somewhat tougher:

black locust	poison ivy
buck brush	willows
elm	tree of heaven
mulberry	

Group 3—Resistant.—So far, no luck with 2,4D:

ash	raspberries
blackberry	red cedar
dogwood	rose, wild
meadowsweet	Osage orange

Annual Weeds

Group 1—Susceptible.—You can kill these easily with about 1 pound of 2,4D per acre:

beggar ticks	mustards
bitter winter cress	peppergrasses
blue bur	pigweeds
butterprint	henbit
carpetweed	mallow
cocklebur	Jimson weed
false flax	kochia
stinkweed	cinquefoil
hemp	sow thistle
annual morning glory	sunflower
mayweed	

Group 2—Intermediate.—These will take from 1½ to 2 pounds per acre, and a little more time to kill:

bedstraw	lamb's quarters
buckwheat, wild	lettuce, wild
chickweeds	smart weeds
dog-fennel	speedwells
dodders	purslane
fleabanes	knotweed

Group 3—Resistant.—These are tough:

buffalo bur	grasses
catchflys	night shade
corn cockle	sandburs

Perennial Weeds

Group 1—Susceptible.—With 1 to 2 pounds of acid per acre you can kill the tops, and often the roots, of these plants with one treatment. Two applications should do the trick:

artichoke	horsetail
hedge bindweed	stinging nettle
buckhorn	plantains
bull thistle	rosin weed
burdock	wormwood
catnip	ground ivy
chicory	gumweed
cinquefoils	heal-all
dandelion	water hemlock
wild sweet potato	wild parsnip
vervains	

Group 2—Intermediate.—These plants are more stubborn. You can kill the tops at early stages, but it will take several treatments of 1½ to 2 pounds of acid per acre to get the roots:

bindweed	sorrel (red, sheep)
buttercups	wild garlic
Canada thistle	wild onion
docks	teasel
dogbane	goldenrods
pokeweed	yarrow
poverty weed	goatsbeard

Group 3—Resistant.—Another tough problem:

asters	milkweeds
cactus, prickly pear	wood sorrel
climbing milkweed	ferns
mullein	nimblewill
ox-eye daisy	horse nettle
ground cherry	

More detailed lists are available in bulletins from the Department of Agriculture, most colleges of agriculture, and experiment stations.

Small Sewage Treatment Plants

IV—Activated Sludge

This article discusses the advantages, factors in design, operation and characteristics of activated sludge plants for small communities. It was prepared at our request by Miles Lamb, Manager of the Sewage Equipment Engineering Department of the Chicago Pump Co. It is the fourth in our series on small sewage treatment plants, the first of which appeared in our February issue. These articles are intended to help solve the problems of 9,058 small communities reported by the Public Health Service to be in need of sewerage facilities.

MILES LAMB
The Chicago Pump Co.

THE aerator-clarifier "Pakage" sewage treatment plant was developed specifically to meet the requirements of sewage treatment for small communities. The need for such development was based on observations that dimensional scaling down of successful applications of sewage treatment processes for large populations does not provide equal effectiveness and resulting satisfactory treatment for a small community. The use of the activated sludge process in these small plants assures the production of a high-quality effluent under a wide variety of operating conditions. This is important because many small towns are located on streams of low summer flow. Also important is the freedom from nuisance, eliminating the need for locating the plant a considerable distance from the town.

Experience in the operation of aerator-clarifier "Pakage" plants for the past ten years has shown that they provide a continuous high-quality effluent under the part-time supervision of the type of operator available to every small town. This has been proven by the satisfactory performance of more than 100 of these plants throughout the country. These plants are being operated by non-technical men who have been trained in the common-sense fundamentals of operation, as well as in the performance of the simple tests that are required for these small plants.

Description of Plant

The aerator-clarifier is the heart of these small plants. It consists of a mechanical aerator, with secondary tank, final weirs and activated sludge control devices. Sludge return is accomplished by the aerator itself. The activated sludge in the secondary tank settles directly into the stream of moving mixed liquor created by the suction to the aerator, giving positive return of the activated sludge to the aeration tank. The aerator maintains continuous circulation and mixing in the aeration tank. It also provides flow through the final tank regardless of incoming sewage flow. This avoids septic conditions in the final tank during low sewage flow.

When installed in an aeration tank, the aerator-clarifier unit provides complete secondary treatment by the activated sludge process. The primary tank, aerator-clarifier, digester and control building can be nested together forming a compact structure of square shape making a plant of pleasing appearance and of economical construction cost. Fig. 1 shows a typical layout.

This type of plant has been developed to provide consistently high quality effluent under the part-time supervision of the type of operators available in the small community. Such men are often mechanically apt, being of the town mechanic type, and intensely interested in their work. They soon learn what is necessary as a routine at their plant to maintain a crystal clear effluent. It may be difficult to get them to maintain conventional data and test records, aside from those for the settling and relative stability, since they often consider such "book work" as unnecessary red tape.

Former coal miners, school teachers, clerks, farmers and laborers have become successful operators of these plants.

Some engineers find it difficult to rationalize the successful operation of "Pakage" plants by these men in comparison to the type of man ordinarily deemed necessary to run a sewage treatment plant. The capabilities of the town mechanic general utility type of man should not be overlooked when considering the problem of sewage treatment.

Design Factors

The correct determination of the volume, strength and characteristics of the sewage to be treated is, of course, the most important step in the design. Knowing the volume and strength of sewage the size of the various structures can be easily determined.

Experience has shown that the old "rule of thumb" method of designing a plant for 100 gals. per person per day does not apply to the small community. Suburban communities generally have larger flows than rural communities. Also the flow varies considerably with the type and condition of the sewer system. In estimating the domestic sewage flow in a community it is recommended that a special study be made in each case. If it is not possible actually to measure the flow, all available information should be gathered such as population connected to the system, city water pumpage, water pumped by others and discharged to the sewer, infiltration, and water consumption habits of the community. The flow can then be estimated and checked on the basis of the above factors.

Experience has shown that two elements are of utmost importance in the design of an activated sludge aeration unit: (1) Sufficient aeration period must be allowed for the process to do the job; and, (2) Sufficient oxygen must be supplied during this time to support the activated sludge. Accordingly, the plants are designed with a detention period in the aeration tank in proportion to the strength of the sewage.

The amount of air necessary is also proportional to the strength of the sewage. Experience gained with over 100 installations, coupled with extensive research, has provided data on which to base the detention period and amount of air for a specific sew-

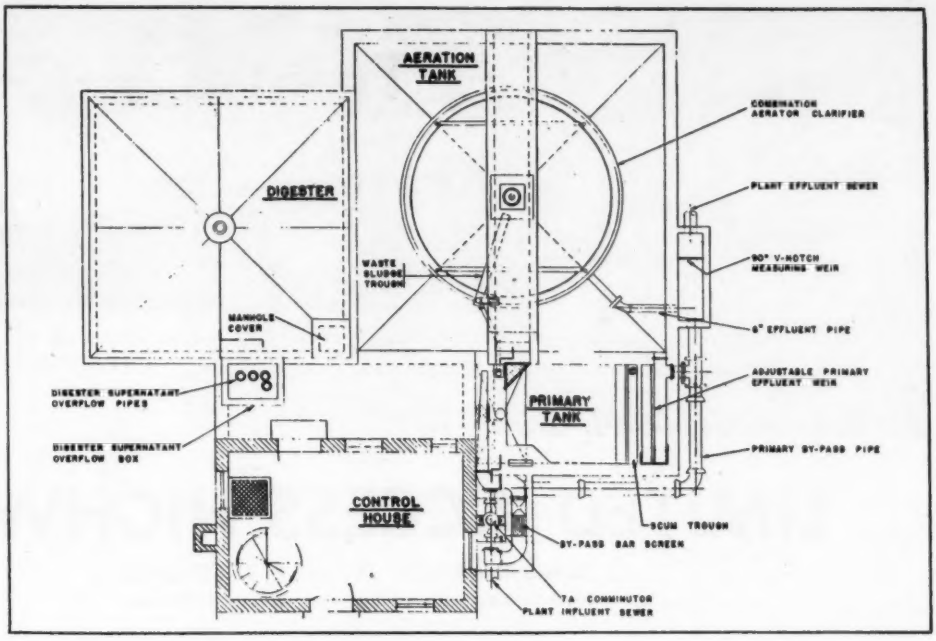


Fig. 1, showing a typical layout of a Chicago activated sludge plant. A view of a plant of similar type at the Soldiers' and Sailors' Children's Home, at Knightstown, Ind., is shown on page 33 of our February issue. Single unit plants handle to 125,000 gpd.

age. Where industrial wastes are present, special care must be exercised to evaluate properly the equivalent load of these wastes and to provide for this load in the design.

Obviously, it is unsound to require the present generation to pay for a sewage plant of greater capacity than it might be reasonably expected to need. The use of this type of plant enables future additions to be made at reasonable cost as needed, since additional aerator-clarifier units may be added as the load requires. This makes it unnecessary to provide large excess capacity in the original design for speculative future loads that may never materialize.

The aerator-clarifier units are manufactured in various sizes designed to handle flows up to 125,000 gpd. Flows up to 500,000 gpd. are handled by using multiple units. The capacities of the various sizes are based upon data obtained by twelve years of operating experience in all parts of the country under a wide variety of operating conditions. For sewages with industrial wastes the units can be adapted to greater loadings by increasing the oxygenation capacity of the aerator.

Plant Operation

These "Pakage" plants are provided with a number of automatic devices to keep the daily tasks which the operator must perform at a minimum. The necessary operations may be performed in a relatively short time, allowing the operator to do other municipal work, such as running the water works, maintaining the streets or acting as policeman or fireman. In the case of institutions, the man who operates the boilers and other equipment at the institution usually operates the sewage plant.

Operators have found by experience that the automatic sludge control feature provides effective control of the solids in the aeration tank and that manual adjustments and testing of the solids are necessary only once or twice a week.

This is true because the solids not needed are simply subtracted from the mixed liquor in proportion to the flow instead of controlling them by any of the various common methods. Since the majority of solids are received at the plant during high flow, the solids are being wasted most rapidly when the load on the plant is the greatest. The result is a wider range of activated sludge solids in the mixed liquor than is conventional or economical for larger plants but the cost of this is negligible against the insurance it provides for continuous successful operation without the necessity of frequent settings of the sludge control device by the operator.

We have found that generally the solids in the mixed liquor will vary from 600 or 700 ppm. to 1,000 or 1,200 ppm. Sufficient power is incorporated in the mechanical aeration device so that the mixed liquor is over-aerated. This provides an adequate safety factor at low premium. The difference between trying to run these small plants at the efficient power consumption figure of the larger plants amounts to no more than 25 to 50 cents per day for additional electricity. This cost is negligible when offset against the fact that the average mechanically minded type of person can supervise the operation of these plants and perform other municipal duties as well, with a savings in salary due to part-time operation far exceeding this small additional power cost.

"Shock" Loads

So-called "shock" loads, either domestic or industrial, are handled in the "Pakage" plant without serious deterioration of the quality of effluent. When applied load greatly exceeds the design load in any machine, structure, or process, certain telltale signs warning of approaching trouble are manifest. For instance, when an electric motor is overloaded the fuse blows. The same is generally true of sewage treatment plants regardless of type of treatment.

Overload conditions are usually caused by unexpected industrial wastes or by extraordinary population increases not anticipated in the design. This is true regardless of the type of treatment. Some condemn the processes when failure results from overloaded conditions. This is false reasoning. If a "Pakage" plant does not handle a reasonable "shock" load, it is a sign that the plant is seriously overloaded. Special controls such as the chlorination of return sludge have been developed to enable a seriously overloaded plant to produce a satisfactory effluent, however, such controls are merely a stop-gap solution to the problem. The

(Continued on page 40)

Courtesy D. C. Dept. of Highways

Artist's conception of K Street crossover at Rock Creek and Potomac Parkway.

Washington's LIMITED ACCESS HIGHWAY

LEWIS R. WATSON, JR., and R. A. BOUCHER
Street Division, Engineer Department District of Columbia

BY 1960, assuming that the District of Columbia's heavy construction program is carried out on schedule, the impatient motorist, destined for points beyond Washington and with little or no inclination for sightseeing, will be able to drive across the city in as little time as the condition of his vehicle and the speed limits will let him.

The need for an all-purpose expressway became urgent during the war years, when it appeared that employment in the Executive Branch of the Federal Government would not drop to prewar levels. The huge population increment was reflected in a proportionate rise in personnel in industry and commercial and service establishments which served the needs of government workers. Also, analyses of population trends in northwest Washington, in Virginia's Arlington County and in Maryland's Montgomery County revealed increases of 50% in some regions over the 1940 census. As a result, all municipal service facilities were dangerously strained under the pressure of maximum demand, but the rigid nature of highway facilities made the traffic problem one of major proportions.

Solving the Problem

In an effort to relieve the situation, the engineering firms of the J. E. Greiner Company, Baltimore, Maryland, and DeLeuw, Cather & Company, Chicago, Illinois were retained to study solutions for the traffic problem. In 1943, and again in 1946, the consultants reported in favor an east-west limited-access highway as the only means of restoring fluidity and safety on the streets of downtown Washington. The report also pointed out that K street was the logical route to improve, in the event that the plan for an expressway was adopted.

Prior to receiving these recommendations, the Department of Highways had investigated the possibility of improving K Street to absorb the increasing traffic volumes, originating in the northwest section of the city and destined, for the most part, to points in the central business and government districts.

This study involved consideration of travel along M Street during those periods of the day when local activity reached its highest point. Obviously, M Street could not be widened and converted economically into a high-speed artery because this would entail the acquisition of numerous real-estate parcels and buildings, either by condemnation or purchase. Highway officials, therefore, concurred in the opinion submitted by the consultants, that K Street offered the greatest number of natural advantages for development as an expressway.

There were other factors which weighed heavily in the selection of K Street. (1) It is the first street, north of Constitution Avenue which extends through the city in a straight line and connects principal arterials to the east and west with the downtown area. (2) It is the widest of several alternate routes from which the choice could be made, and it provides the necessary space required by the improvements between the building lines without resorting to excessive condemnation. (3) The inductive power of the new highway would be exercised on traffic flowing into the downtown section from points of origin lying west of Connecticut Avenue, and on traffic originating in the communities across the Potomac River which enter via Francis Scott Key Bridge. (4) At its eastern terminus, K Street ties in conveniently with new construction which will eventually form a junction with the proposed Washington-Baltimore Freeway.

What Has Been Done

Realization of this long-range program began in 1940, with the erection of a combination structure, consisting of a grade separation and bridge, between 27th Street and 29th Street. This construction is of reinforced concrete supported on concrete piles, the spans, approximately 69′ in length, being rigid frame structures which carry two 22′ roadways and two 3′ walkways over Rock Creek and Rock Creek & Potomac Parkway. Connections between K Street and the low-level Parkway which underpasses it, is provided by a ramp 22′ wide and a walkway 7′ wide on each side of the span over Rock Creek. The exterior faces of the spans, the retaining walls, and all handrails are of masonry. The structure was designed by Harrington & Cortelyou, Consulting Engineers, Kansas City, Mo., and built for approximately $239,800.

In 1946, bids were invited for the construction of a section of an elevated highway on K Street and a

jacent right-of-ways by the Engineer Commissioner of the District of Columbia. Thus, the second stage in the long-deferred program for a mid-city expressway, which had been interrupted by the war, was initiated. The plans and specifications were prepared by Harrington & Cortelyou and Louis Justement, consulting architect. The structure was designed to extend from the existing grade separation and bridge at 27th Street which would be modified to join the elevated highway. Underpassing Francis Scott Key Bridge, it would then connect to M Street and Canal Road at the western end of the project, in the vicinity of 36th Street, and to Key Bridge via two ramps, one westerly of and up to the bridge and the other easterly of and down from the bridge. The standard cross-section provided two roadways, each 22'9" wide, with a dividing strip 2'6" wide and suitable variations from the standard design to connect to existing structures at each end.

The necessary alterations at the 27th Street end will consist of additional construction on each side of the central section of the existing structure, and over the lower roadway connections between K Street and the Parkway, in the form of high-level roadways 23' wide. These separated roadways merge beyond Rock Creek into the standard divided highway. Minor structural adjustments only will be required to join the new highway with the existing structure which consists of retaining walls east of the Parkway, rigid frame structures over the Parkway and continuous girder spans westerly therefrom to 29th Street. This construction will be of reinforced concrete faced with masonry on the exterior faces.

Courtesy D. C. Dept. of Highways

Approach and exit ramps at Francis Scott Key Bridge.

From the vicinity of 29th Street, the main elevated roadway will extend for approximately 3550 ft. along K Street. The elevation of 25 feet will provide sufficient headroom for railroad traffic at grade. This area is industrial, and the depressive effect on real-estate values will be small. The elevated roadway will be of steel girder and column construction, with concrete deck and pipe railings and concrete foundations which are supported in part on concrete piles, and in part on rock.

A network of connecting roadways at the west end of the structure will provide accessibility to and from Key Bridge, Canal Road and M Street. The ramp connection designed for use by eastbound traffic will comprise seven spans of reinforced concrete girders, columns and foundations, and will be flared at the junction to allow descending vehicles to merge into the traffic stream. The ramp leading up to Key Bridge, designed for westbound traffic, will cross the Chesapeake & Ohio Canal on a two-span, reinforced concrete girder structure and from there, will be carried on fill behind concrete retaining walls to the connection to Key Bridge at its north (Georgetown) abutment.

The link with M Street and Canal Road will be in the vicinity of 36th Street. It will comprise a two-span, reinforced concrete girder structure which will carry the standard cross-section of two 22'9" roadways over the Chesapeake & Ohio Canal and provide a single sidewalk 4' wide on the easterly side for pedestrian traffic. A stairway extends from this sidewalk to the level of the south bank of the Canal, and another stairway west of the abutment connects between the intermediate level and the present grade of K Street.

The development of K Street as an east-west limited-access highway is still in the preliminary stages. The project, however, continues to rank as one of the most serious attempts so far proposed by the D. C. Department of Highways' planning staff to solve permanently the problem of moving through east-west traffic across congested intersections in the downtown area, at maximum speed with minimum hazard. K Street is the key to the solution.

Courtesy D. C. Dept. of Highways

Existing crossing of K Street over Rock Creek and Potomac Parkway.

Night Lighting for a Village Ball Park

A baseball diamond, lighted for night games, has been constructed at Young America, Minn., a village of about 400 population. The cost of the lighting installation was about $14,000. There are eight 80-ft metal towers and four 37½-kvh transformers. The two main towers mount 24, 1,500-watt lights and the other 6 towers carry 16 lights each, also 1,500-watt.

How Cities Charge for Private Fire Protection Services

The most popular method of fire service charging is based on the size of the service connection. 44% of the cities and private companies who report on charges use this method. Average annual costs are $21 for 2" connections, $46 for 4", $75 for 6" and $111 for 8". Prices range widely, as for example from $30 to $120 for a 6" connection.

Yearly charges for sprinkler head systems vary from 3¢ to 12¢ per head, and average 7¢. Some cities make a minimum charge up to $60. The highest private hydrant rental reported was $300 per year, considerably above the average charge of $45. A number of cities make a flat charge for unmetered fire protection service, at the average rate of $36 per year.

THE charges made by municipal and private water departments for private fire protection services, such as automatic sprinklers, have been reported to us by several hundred cities. A portion of the first installment of the replies received are presented in this issue. In order to facilitate comparisons, replies have been grouped geographically. Unless otherwise specified, charges are for a fire connection service.

The West North Central States

Iowa.—Boone, Geo. A. Nelson, City Engineer, has a graduated charge per sprinkler head. Keokuk, W. L. Garrison, Supt., Water Works, charges $72.50 per year for 1,000 heads; additional heads at 7¢ each. No charge for this service is made by Atlantic, Cedar Rapids, Centerville, Iowa City, Marshalltown, Muscatine, Osceola, Red Oak and Sibley.

Kansas.—No charge is reported by the following cities: Blue Rapids, Caney, Dighton, Dodge City, Emporia, Horton, Olathe, Seneca, Wellington and Wichita.

Minnesota.—Little Falls, E. W. Downward, Water Supt. & City Engr., charges $25 per quarter. Springfield, John A. Plamann, Supt. of Utilities, charges $300 yearly for hydrant rental. Stillwater, Herbert S. Grove, Gen. Mgr., has an annual charge of 8¢ per sprinkler head. In Albert Lea, Caledonia, Edina, Hutchinson, Luverne, Marshall, St. Louis Park, Montevideo, Owatonna, St. Peter, Virginia and Willmar no charge is made for such service.

Missouri.—Columbia, D. Elrow Crane, Supt., Water & Light Dept., makes a quarterly charge of $1.50. St. Louis, Thos. J. Skinker, Water Commissioner, charges $5 a year for 4" and larger connections. Springfield, Raymond E. Piner, Supt., Water Co., charges 5¢ per sprinkler head, and $50 minimum. No charge is made for such services by Bethany, Boonville, Butler, Higginsville, Liberty, Macon, Perryville and Poplar Bluff.

Nebraska.—Lincoln, D. L. Erickson, Dir. of Parks, Public Property and Improvements, charges 10¢ per M. gallons when such services are metered through a separate sprinkling or air-conditioning meter. In Omaha, John C. Detweiler, Water Engr., the charge varies with the size of the connection. Alliance, Aurora, Fairbury, Holdredge, Norfolk, Superior, Sidney and York make no charge.

North Dakota.—Bismarck, Dickinson, Valley City and Williston report that no charge is made for fire protection services.

South Dakota.—No charge is reported by Aberdeen and Deadwood.

New England

Connecticut.—Bristol, Frank J. Thiery, Supt., charges $30 annually for a 4" connection, $60 for a 6" and $120 for an 8". Hartford makes no charge. Torrington, A. M. Lawton, Treas., Torrington Water Co., reports yearly charges as follows: 5¢ per head for sprinklers; $7.50 per opening for standpipes; private hydrants, $20. Watertown, Bronson E. Lockwood, Supt. & Engr., charges 3¢ per head per year.

Maine.—Augusta, Sidney S. Anthony, Supt. & Engr., Augusta Water Dist., charges 5¢ per sprinkler head per year, and varying amounts for hose standpipes according to size. Rockland, Allan F. McAlary, Supt. & Treas., charges per year $80 for a 4" service; $120 for a 6" and $160 for an 8". North Anson, Wm. G. Hartwell, Supt. & Treas., charges 7¢ per sprinkler head. No charge is made for sprinkler heads where the charge at regular rates for water used is in excess of the amount charged for such sprinkler protection. Auburn does not charge for this service.

Massachusetts.—Monson, Herman H. Winter, Supt., charges each mill $50 a year for sprinkler service and $10 for each hydrant. Salisbury, R. F. Ruhp. Mgr., charges 10¢ per sprinkler head per year. Williamstown, Chas. F. Notsley, Supt., Water Dept., charges $60 a year for a 4" service, $120 for a 6" and $200 for an 8". Athol, Bruckton, Danvers, Foxboro, Greenfield, Lexington, Manchester, Milton, North Andover, Palmer, Rockland, Spencer, Springfield, Walpole, Ware and Westfield do not charge.

New Hampshire.—Berlin, E. E. Tankard, Supt., makes a yearly charge of 4½¢ per sprinkler head. Laconia, Theodore L. Cate, Supt., reports charges as follows: Minimum charge of $7.50 semi-annually up to 100 heads; additional heads, 1½¢ up to 500; 500 to 1,000 heads, 1¢; 1,000 heads, ½¢. Farmington makes no charge for this service.

Rhode Island.—Woonsocket, Clarence W. Mills, Supt., reports that the owner pays for the installation, the cost not exceeding $10 per year.

Vermont.—Brattleboro, Justin A. Holden, Supt., reports a charge of $60 per year for the first 700 heads, and $55 for each additional 700 heads, or part. Montpelier, D. R. Donohue, Water Commr., expects to make a charge for the service next year. St. Johnsbury, C. S. Sumner, Municipal Mgr., charges $25 per year. Bellows Falls, Newport, Randolph and Rutland do not charge for the service.

Pacific States

California.—Anaheim, V. W. Hannum, Supt., charges annually $9 for a 2" service, $12 for 3", $24 for 4"

$36 for 6", $60 for 8", and $96 for 10", and the consumer pays the installation cost. Burlingame, K. S. Fitch, Dir. of Pub. Wks. and City Engr., makes a charge based on the size of the main—$3.50 per month standby for 6". Monterey Park, H. T. Gould, Water Supt., reports a charge by size of line, per month, as follows: 2", $1; 3", $1.50; 4", $2; 6", $4; and 8", $8. Stockton, Frank Suters, Manager, charges $1 per inch diameter of service. Vallejo, T. D. Kilkenny, City Engineer, charges, but gave no rates. Alhambra, Calexico, Escondido, Fullerton, LaMesa, Lindsay, Los Angeles, Manhattan Beach, Orange, Pittsburg, Riverside do not charge.

Oregon.—Coos Bay and North Bend, Walter S. Chiene, Mgr., Coos Bay-North Bend Water Board, make a charge which is determined by the size of the service—2", $2.40; 3", $5.40; 4", $9.60; 6", $21.60. Eugene, W. J. Moore, Supt. of Water Operations, report the charge for unmetered services is 60¢ per inch per month on sealed systems. Hood River and Ontario do not make a charge.

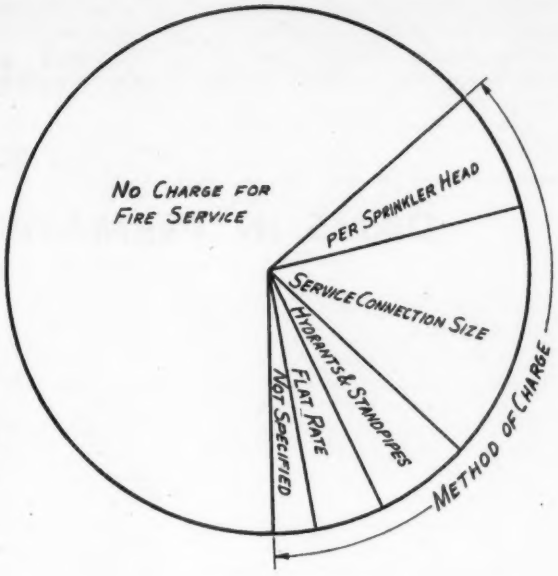
Washington.—Bellingham, Henry J. Donnelly, Supt., makes a charge for standby as follows: 2", $1; 3", $1.25; 4", $2; 6", $3; 8", $4; 10", $5, and 12", $6. Tacoma, W. A. Kunigk, Supt. of Water Division, reports a commercial rate for mixed service; double rate if used for other than fire. Walla Walla, Grova C. Cookerly, City Engr., reports that sprinklers must be metered. Anacortes, Colfax, Dayton, Mount Vernon, Pullman, Snohomish and Wenatchee make no charge.

West South Central

Arkansas.—Hope, C. O. Thomas, Mgr. and City Engineer, and Little Rock, L. A. Jackson, Manager and Engineer, do not charge for such services. Charges are made by other cities as follows: Jonesboro, N. B. Thayer, Manager, $75 per year per 1,000 units, plus 6¢ each thereafter; Malvern, J. A. Wallis, Supt., $12 per year for private hydrants, and $60 per year for each sprinkler system, 1,000 heads or less. Marianna, S. Sanderson, Supt., $12 per year for each connection.

Louisiana.—Bastrop, F. E. Dunham, Gen. Mgr., Peoples Water Service Co., reports yearly charges as follows: 4" and 6" connections, $30; 8", $40. Each allows 250 sprinkler heads, excess of 250 at 10¢ per head per year. No charge is made in Alexandria and Jennings.

Oklahoma.—No charge is reported by Durant, Henryetta, Okemah and Pawhuska.



This chart shows graphically how some 500 cities in the United States handle the problem of charging for private fire protection. The most of them make no specific charge.

Texas.—Alamo Heights, Bonham, Commerce, Dallas, Jacksonville, Lamesa, Lampasas, Paris and Temple do not charge for such service.

East South Central

Alabama.—Sheffield, W. E. Hooper, General Manager, reports that a charge is made for automatic sprinklers of 10¢ per head. Talladega, A. R. Decatur, Clerk, also charges, but the rates were not given.

Kentucky. — Frankfort, H. K. Hines, Plant Mgr., charges per year for fire service: fire hydrants, $25; 2" connections, $12; 4", $30; 6", $60. Hopkinsville, Jack Boxley, Mgr., Sew. & Water Works Comm., charges according to the size of the feed line —$60 per year for a 4" line; $108 for a 6" and $156 for an 8". Louisville, B. E. Payne, Chief Engr. & Supt., has monthly charges as follows: 4" service, $1.50; 6", $2.50; 8", $4.00; 10", $6.50 (a discount of 33⅓% is allowed). Middleboro, J. H. Woodson, Dist. Mgr., charges $40 per year, the same as for city fire hydrants. Cynthiana, Danville, Franklin, Hazard and Murray report that no charge is made for this service.

Mississippi.—Jackson, Baxter F. Wade, Supt., reports a charge of $48 yearly which covers 1,000 sprinkler heads, and additional heads at 4¢, 3¢ and 2¢ each. No charge is made by Amory, Belzoni and Meridian.

Tennessee. — Greenville, J. W. McAmis, Supt. of Water Works & Sewers, reports the following charges: Minimum, $25 yearly for a 6" connection and $40 for an 8"; 5¢ per head in excess of minimum. Nashville, R. L. Lawrence, Jr., Director, Waterworks Dept., charges 5¢ per sprinkler head for unmetered fire services within the city limits with a minimum charge of $15 per year. All fire services, without the corporate limits of the city, must be metered with an Underwriters approved fire meter and an annual service charge of $100 is made for all automatic sprinkler systems, without the corporate limits, connected with the waterworks system of the city. Shelbyville, P. J. Scudder, Engineer, makes a charge of $50 per year per valve head. No charge is made by Milan.

Mountain

Arizona.—Flagstaff, Hayes Weidner, Water and Sewer Supt., and Jerome, Earl A. Spitler, Asst. Supt., make no charge. Prescott, Stuart P. Henderson, Supt., reports that there are no such services. Tucson, Phil. J. Martin, City Manager, charges for such services, but does not give the rates.

Colorado. — Denver, Geo. F. Hughes, Executive Secretary, charges $4.50 per month for 4", $9 for 6" and $13.50 for 8". Fort Collins, Burgis G. Coy, City Engr. and Water Works Supt., charges $35 to $60 for fire hydrants. Alamosa, Boulder, Colorado Springs, Fort Morgan, La Junta, Louisville and Trinidad do not charge.

Idaho.—Boise, H. R. Vinson, Pres. & Gen. Mgr., Boise Water Corp., charges on the size of service. Pocatello, W. I. Spier, charges according to the size of the line (the charges are being revised at the present time). Preston, Rupert and Sandpoint do not charge for such services.

Montana.—The cities of Dillon,

Forsyth, Kalispell and Livingston make no charge for such service.

New Mexico.—Deming, Las Vegas, Raton and Santa Fe do not charge for this service.

Nevada.—No charge is reported by Las Vegas.

Utah.—No charge for this service is made by Toole City.

Wyoming.—Casper and Sheridan do not make a charge for this service.

Data from other sections will appear in an early issue.

DAMS IN PERMAFROST

(Continued from page 23)

4) The main body of the dam must be kept dry, so as to resist freezing without damage.
5) The dam must be water tight under extreme variations of temperature (160°F).
6) The facing of the dam must resist severe ice thrust and wear.
7) The materials comprising the dam must, in themselves, resist severe climatic conditions.
8 The shear stresses in the soil must be kept at a minimum.

To ascertain whether the various types of dams satisfy these conditions, they are analyzed subsequently.

Dams on Rock Formations

For dams built on frozen rock, either masonry, timber, rockfill, or earth dams can be used, whichever material is available economically.

Masonry dams should be of the gravity type, since neither the buttress type, nor single arch dams provide sufficient insulation to prevent the cold from penetrating from the downstream face into the reservoir. Thin-shelled dams can be used, provided they are protected by earth fill on the downstream side. However, such earth backfill makes the dam uneconomical. Furthermore, the earth backfill exerts against the downstream face an earth pressure which must be resisted by the masonry shell when the reservoir is low or empty. This practical consideration eliminates thin-shelled dams for permafrost conditions.

In design and construction of gravity dams on rock, special attention should be paid to the amount of ice in the rock, and consequently to possible settlements. Since the permafrost table recedes farther on the upstream side of the dam, the settlement is not uniform. Therefore, the dam tends to tilt upstream. If the foundation is defrosted before construction of the dam, and later allowed to freeze again, the refreezing will lift the dam and tilt it downstream. To provide for such deformations, the dam should have more expansion joints than under normal conditions. Blocks of not more than 30 ft. in width are suggested. In addition, the expansion joints should be large enough to allow for temperature variations from +100°F to −60°F. They also should have no keys whatsoever, thus permitting free settlement of each individual block. Waterproofing of expansion joints should be detailed to provide for all of these conditions. Further, it seems advisable to incorporate provisions for repairs to the waterproofing under full reservoir conditions.

To minimize the ice thrust, and thus the volume of masonry, it is suggested that means for reduction of the ice thrust be incorporated in the design of the gravity dam. Methods of artificially reducing the thickness of the ice sheet in front of the dam may be used; or the thrust of ice sheet can be reduced by inclining the upper 15 ft. of the dam, thus allowing the ice sheet to deflect upward over it. To be effective, the inclination should be not less than 45° from the vertical. Inasmuch as special attention should be paid to the surface of the upstream face of the dam, a vacuum concrete finish and air-entrained concrete should be considered in this connection.

The next installment will consider dams on sedimentary formations, earthfill dams, protection of the dam faces, spillways and construction methods.

Letters to the Editor

(Continued from page 12)

take as individuals, and print it in PUBLIC WORKS, I am sure that your readers . . . would follow your advice. Or—would you be investigated?—*A Former Sanitary Corps Officer.*

(Ed Note: No, we wouldn't be investigated. Nor are all army officers like our familiar friend Major Brushoff. Most of them are very decent folks who are afraid to do much out of the ordinary and so take the easy way out; some few are outstanding men. But what wasn't done in the army back in civil war days is mighty hard to put over with a lot of them. Joe Gilbert was a big source of embarrassment to a good many high officers; when they told him a thing simply couldn't be done, Joe would say "Why?" and usually there wasn't any easy answer to that.)

TRICKLING FILTERS:

It is not possible to publish here all of the letters we have received in regards to the trickling filter reprints; but we do wish to thank the men who contributed so generously of their time and knowledge to make that series of articles so outstanding. Ed.

Vertical Sand Drains

(Continued from page 19)

soil and wash it to the surface through the other space. The driven mandrel has given best results in working to depths up to 40 ft. in soft mud or peat; but pulling is difficult in some clay soils, driving through sand lenses is hard, and the jar of driving sets up vibrations that may be undesirable. The jetted mandrels eliminate most of these objectionable features and give rapid penetration, but require much water.

The sand used for backfilling the drain holes must be sufficiently pervious to provide rapid drainage but must not contain voids large enough to permit silting from the surrounding soil. That used in California jobs is carefully graded, with 90-100% passing a ½" sieve, 25-100% a No. 8, 10-30% a No. 5 and 0-2% a No. 200. The sand fill material has 80-100% passing a ⅜" sieve, 5 to 50% a No. 8, 0-20% a No. 30, and 0-5% a No. 50.

The average cost of completed drain, including drilling or punching the hole and the sand backfill, for major projects during 1946 and 1947 (driven and jetted mandrel) was slightly more than $1.00 per lineal foot.

Road Machinery for Milwaukee County

John E. Hubel

Milwaukee County is to purchase about $45,000 worth of machinery and equipment for road work, the county board having approved such purchase in February. The amount set aside for road building and repair machinery includes eleven trucks; two power graders; one each tractor mower, power saw, flushing truck and power spray; three sand spreaders and repair shop equipment. Advertisements for bids were sent out in February.

Bulk Refuse Collectors Help in KEEPING BOSTON CLEAN

NO city official should envy the refuse collection job that Boston faces in its South Boston section. The blocks in this densely populated area are cut with narrow alleys down which trash cans must be rolled as far as 300 feet, and is plagued with thoughtless folks who consider any street corner a suitable place to dump parcels of trash and garbage. Although contractors have been hired to remove refuse from other sections of the city, this area, and the adjoining market district, have always been the city's own problem.

In an effort to reduce the high cost of collection under these conditions and improve the cleanliness of the area, Boston's Commissioner of Public Works, Robert P. Curley, decided to experiment with the Dempster-Dumpster bulk refuse collection system. The success of the experiment is indicated by its expansion, since the first three of these bulk collectors were put in use in January, 1947, to its present set-up of 42 boxes. Of these 35 boxes are on permanent location in a mile square area with seven spares available for special use. Most of these containers hold 8 cubic yards although some 4- and 6-yard boxes are in service. These 42 boxes are handled by two trucks equipped with suitable hoists.

Adolph J. Post, Sanitation Department Engineer explains the three principal ways in which the Dempster bulk collectors have proved very effective, as follows:

'Leapfrogging' Saves Trucks

A total of 27 alleys in the rooming-house section of this area are too narrow to permit passage of a truck. This necessitates rolling trash cans as far as 300 feet before they can be emptied and returned to position. Multiplying such a distance by 50 or 100 cans in a single alley will give some idea of the time that a dump truck and five-man crew were tied up in one location.

Regular collections are now made from the alleys with a minimum of waste time by the "leapfrog" system. An empty bulk container is placed at the alley mouth, and while a three-man roll-out crew emptied trash into this box the truck is free to pick up the box from the preceding alley and dispose of its contents. This empty is returned to the next alley in succession and the cycle repeated until the schedule is complete. In addition to the saving in time the tightly closed box prevents nuisance from blowing papers while the load is transported.

The Problem of the Surreptitious Cooks

In other respects besides its narrow alleys the South Boston area presents unique problems. This section consists largely of low-rent rooming houses where lodgers are seldom permitted to do their own cooking. Despite this restriction a great deal of small-scale cooking is done over gas jets in the rooms. To conceal this activity the offenders have a habit of wrapping their garbage in newspapers and carrying it out for disposal. Householders soon found their trash cans overflowing with such "parcel post" packages so they moved them to more inaccessible places. This resulted in an accumulation of bundles of trash in vacant lots, gutters and alleys, where they created an enormous nuisance and a potential disease hazard. The only answer was for the city to provide suitable refuse containers convenient enough to assure their use. The establishment of 35 bulk containers in strategic locations throughout the troublesome area has solved the "parcel post" problem and immeasurably reduced the work of street cleaning crews. The truck crews of two men make about 15 trips a day on a regular schedule for emptying these boxes and working with the roll-out crews.

Hosing out a Dumpster.

Picking up a Dumpster from the curb.

The Market and the Pushcarts

An army of pushcart peddlers selling fruits and vegetables invade the market district every Saturday night and deposit great quantities of refuse before they leave. Trash cans placed in the area were wholly inadequate for, like the residents of the rooming house section, the peddlers found the gutters the most convenient place to leave their trash and garbage. The problem of keeping the market clean has been solved since the Dumpsters were put in use. Now five collection

Courtesy Christian Science Monitor

The box dumps cleanly into the narrow slot to the scows.

boxes are placed in the area each Saturday night and the police, aided by two sanitation department men, enforce their use. A truck hoisting unit, kept on duty to shuttle the boxes to disposal points, carries an average of 30 loads in a night.

Disposal Is by Scows

The rubbish collected from the market, as well as all other sources in the section, is carried away from the city in scows stationed at specially constructed loading points. The scow is placed in a slip or pen over which a truck ramp is built. Trucks back up to a long slot located over the center of the slip and dump their loads directly into the scow. The convenience of this dumping arrangement, coupled with the short hauls in the Dumpster-served waterfront area make it possible to return an empty box, pick up a full one and dump it in a little over ten minutes. In the summer months a few minutes more are spent on each cycle to hose out thoroughly the collection boxes before returning them to their locations.

The residents of South Boston quickly recognized the increased cleanliness of their neighborhood since the nuisance-free gray containers have been put in use. They also appreciate the cooperation of the city in placing bulk containers temporarily on private property which the owner is cleaning. Many other requests have been made for the establishment of permanently located boxes, and these are being filled as more units are put into service.

Without a doubt, South Boston has a tough refuse job to handle, but as department foreman Ed Fitzgerald says, "The Dumpsters just fit our problem."

Sewerage Authority for Linden-Roselle

FOLLOWING an exhaustive study and report by Alexander Potter Associates, New York, consulting engineers, upon engineering, administration and financing a $2,500,000 pollution abatement project for the city of Linden and borough of Roselle, New Jersey, both communities have formed a Sewerage Authority to administer and finance the Project. The Sewerage Authority consists of four appointed members, the three from Linden being Herbert D. Banta, Charles H. Gross, Edward Mrozek, and the one from Roselle being Franklin Hudson, who was elected Chairman.

The present population of the communities in this project is only about 50,000. The area, however, is highly industrialized and the pollution abatement problem is considerably intensified on this account. Nationally known industrial establishments situated in this area include Merck & Company; General Motors; American Cyanamid; Cities Service Oil Co., Distillers Lt'd.; General Aniline Co.; Standard Oil Co. of New Jersey, and others. Many of these industries are not now connected to municipal sewers. The industries served by the municipal system contribute about 3 million gallons of waste daily with a "population equivalent" of about 235,000 people. The industries not utilizing the municipal system produce a daily waste volume of 39 million gallons having a population equivalent of nearly 150,000 people. Some of the latter industries have private treatment facilities and may continue their operation independently.

Of the various methods considered by the Engineers, for administering, financing and apportioning costs to the two cities and to the industries, the Sewerage Authority scheme, which was made legally possible by recently enacted state legislation, was recommended and adopted. One of the principal objectives of the enabling legislation relative to the Sewerage Authority, is to overcome the resulting debt burden on the municipalities that would occur from financing the cost of the sewerage works by the usual general obligation bonds. The Authority is endowed with adequate powers to issue its own bonds for financing construction and such bonds are not charged against the borrowing power of the municipalities involved. The bonds of the Authority are in effect revenue bonds; the Authority being empowered to collect from the direct or indirect users of its facility the necessary charges sufficient to maintain its operation on a self-supporting basis.

A City Manager Reports On the Public Dump

Little needs to be said of the Town's No. 1 nuisance, the Public Dump. Located beyond the outskirts of the town proper at its westerly edge, this unsanitary method of waste disposal has lived through another year. The abundant rat population, the chronic smoke nuisance and the ever present danger of disease inherent in filth are outstanding features of this much used facility. Even the cost of maintenance is becoming to be a seriously objectionable factor, in view of the other aforementioned conditions.

All rubbish and garbage is hauled by private collectors. Considerable refuse is hauled into this spot from adjacent towns.

Steps to establish municipal collection of all garbage and rubbish and to operate a more sanitary means of disposal are being seriously considered by interested citizens. Another year should result in the preparation of a thorough report on this subject. In the meantime it is hoped that some steps can be taken in 1948 to operate the dump in a more sanitary manner, incorporating principals of the sanitary fill method as much as possible. From the Annual Report of the Town Manager of Houlton, Me., Robert L. Price.

A Symposium on

CHLORINE DIOXIDE

Experiences at Cedar Rapids

A. K. Cherry, Chemist, and Ben Coates, Director of Purification

THE Cedar Rapids water purification and softening plant has been using chlorine dioxide, in combating tastes and odors, since February, 1946. The raw supply is obtained from the Cedar River and the odor problems are caused by decayed vegetation and algae. The most difficult to remove are those due to the liberation of distasteful oils from microscopic organisms.

Chlorine dioxide is generated by mixing solutions of sodium chlorite and chlorine in a glass chamber or generator, designed for this purpose. The sodium chlorite solution is batch mixed, using 9.9 pounds of the chemical in 50 gallons of water; the strength of the chlorine solution is adjusted to contain about 0.8 grams of chlorine per liter of water. The two solutions enter at the bottom of a glass generator, which is filled with Raschig rings to aid in mixing the two solutions, and the chlorine dioxide solution passes out at the top and is conducted through a hose line to the inlet of the filtered water clear well. The ratio of chlorine to chlorite used here is about 1 to 1.25 by weight.

Stainless steel tanks are used for the chlorite solution and a proportioneer pump feeds it to the generator. The chlorine solution is obtained by feeding chlorine from a chlorinator into a simple aspirator type mixer where it is mixed with the required amount of water and then discharged into the generator.

Since the inaugural of chlorine dioxide, it has been used about fifty percent of the time. Whenever conditions warrant, it is discontinued for the sake of economy. To date the average dosage of sodium chlorite when used has been 2.3 pounds per million gallons, which costs about $1.73.

This treatment has proven quite satisfactory in reducing tastes and odors, although it is not as effective in oxidizing the distasteful oils from microscopic organisms as had been anticipated. It was learned, however, that by carrying a high free chlorine residual through the pretreatment, or sedimentation process before filtering, which gives the chlorine 3½ to 5 hours contact, and by following up with chlorine dioxide after filtration, a satisfactory water could be produced.

The flow of the Cedar River, our source of supply, was very low last summer due to drought conditions, and algae were present in unusually large numbers. Threshold odors of the river water at the plant, after addition of copper sulfate at the intake station, but before any other treatment, reached 50 to 60. Still it was possible, with the addition of sufficient pre-chlorine to carry at least 0.8 ppm. residual in the filter effluent, and with a normal dosage of chlorine dioxide, to produce water with an odor index of not more than 3, usually 2 or less. The pre-chlorine required during this period varied from 2.1 to 3.8 ppm., while the sodium chlorite used for chlorine dioxide was 1½ to 4 pounds per million.

Before the advent of chlorine dioxide, the chlorine-ammonia treatment employed did not completely oxidize the slowly reacting organic compounds, with the result that they would destroy the chlorine residual in the distributing reservoir, necessitating addition of more chlorine at this point in order to maintain a protective residual throughout the system. With the chlorine dioxide treatment it has been possible to maintain the required chlorine residual in all parts of the system without further addition of chlorine in the reservoir. The bacterial quality has been improved, due to the higher pre-chlorine dosages which were applied.

In general, the results of the chlorine dioxide treatment have been very satisfactorv when used in conjunction with an effective preliminary treatment, and the cost has proven somewhat less than that of the methods used in former years.

Chlorine dioxide generating equipment, Cedar Rapids, Ia.

Safe and Palatable Water at Northampton

J. C. DE GROOT
Manager Water Dept.

CONTROL of tastes and odors is usually a seasonal problem at Northampton, Pa., generally occurring during the spring season and becoming intensified as temperatures rise. Our source of supply is a series of springs and the run-off from a 6-sq. mi. watershed. The water is collected in a 100 mg impounding reservoir, from which it flows by gravity to sedimentation basins and through rapid sand filters and, after complete sterilization, is pumped to the distribution reservoir. Each spring, as a general rule, the algae count in the raw water rises continuously, various types having been identified microscopically. By treating the impounding reservoir with copper sulfate, using 3 to 8 lb. per mg, we usually succeeded in killing most of the taste-causing organisms. Following this, we have streaked the 3,200,000-gal. distribution reservoir with copper sulfate at the rate of 3 lb. per mg to kill any organisms that may have come through the filters. By this method we have been fairly succesful in keeping obnoxious tastes and odors out of the distribution system.

However, impressed by the results obtained at Niagara Falls by use of chlorine dioxide, we contacted the Mathieson Alkali Works with a view to trying the use of chlorine dioxide to control the taste and odor without the use of carbon and ammonia. This company in cooperation with Wallace & Tiernan agreed to furnish, on an experimental basis, the apparatus necessary to generate and feed chlorine dioxide; and the use of this started on April 23, 1946.

We had been using normally 3 ppm of carbon, 0.75 ppm of chlorine in pre-chlorination and 0.5 ppm in post-chlorination, and 0.6 ppm of ammonia. In starting the new treatment, we eliminated entirely the use of carbon and ammonia. We were advised that, in view of applying the chlorine dioxide in our clear well, it would be necessary to have a flash chlorine residual after filtration of 0.10 ppm, which necessitated increasing the pre-chlorination dose to 1.0 ppm.

After several days' trial, we were convinced that our effluent was definitely improved. We maintain a constant check on the chlorine residuals, carrying 0.4 ppm leaving the plant and 0.05 ppm at the extreme end of the distribution system, without prevalent taste. Within several weeks our bacteriological analyses showed fewer colonies on agar 37° in 24 and 48 hr., indicating more complete disinfection and a generally improved effluent.

In order to determine definitely whether the chlorine dioxide treatment should be credited with the improvement, we refrained from using copper sulfate in the impounding reservoir when the algae began increasing, but by increasing the chlorine dioxide dose gradually we were entirely successful in preventing tastes from getting into our distribution system. The highest dosage to date has been 1 ppm of Na $C10_2$, used when there were 520 Asterionella per cc, 80 Synedra, 120 Synura, 50 Tetraspora and 50 Cyclops, or a total of 820 organisms per cc.

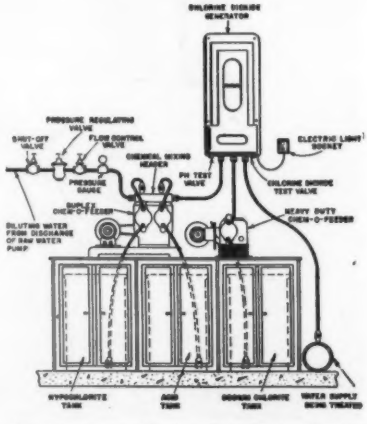
In applying this treatment, we used a 25-gal. stone crock 21½" deep for holding the solution, from which it was fed by a Wallace & Tiernan metering pump into the discharge line of the post-chlorinator, the conversion of the sodium chlorite to chlorine dioxide taking place in a glass-mixing and generating apparatus and the mixture then entering the clear well. Chlorine was used on a pound for pound basis with dry Na $C10_2$.

While we do not believe that chlorine dioxide is a cure-all for taste and odor problems, we can truthfully say, after approximately 18 months of use, that we consider it a very useful adjunct in the treatment of such problems. Perhaps it is better adapted for use at our plant in the summer months, when the algae are more prevalent; while possibly an equally palatable water can be produced in the winter months by use of ammonia and activated carbon. The overall cost of chlorine dioxide treatment has been higher than that used previously, but it enables us to eliminate many of the normal bacteria in the distribution system and to deliver a more palatable water.

Results at Michigan City, Indiana

H. J. DRAVES
Superintendent Dept. of Water

AT the Michigan City, Ind., water purification plant a trial run with chlorine dioxide was made from May 23rd to June 3rd, 1947. We had been pre-chlorinating at the breakpoint rate of 14 to 16 lb. per mg in the raw water well. We were having some slight nitrogen tri-chloride odors in most parts of the distribution system, and started feeding chlorine dioxide as a post treatment at the rate of 2 lb. per mg sodium chlorite with 1 lb. of chlorine. This did not prevent odors in the distribution system and we increased the post treatment to 4 lb. of sodium chlorite and 2 lb. of chlorine. This had a tendency to increase the residual, and when this exceeded 0.50 ppm we got a nitrogen trichloride odor.



Proportioneers chlorine dioxide installation.

A similar trial run was made a month later, but with the prechlorination both breakpoint and marginal, and using first 4 lb. of both sodium chlorite and chlorine, and later 6 lb. of each. The latter eliminated the algae odors but not the nitrogen trichloride.

A third run was made between July 24th and 28th. The water had a temperature of 70° and a very musty odor, and we had been using 30 lb. of chlorine per mg in the raw water well, 128 lb. of carbon at the mixing chamber, and post-chlorinating at the rate of 3 lb. Feeding chlorine dioxide to the raw wells at 7.5 lb. of sodium chlorite and of chlorine did not entirely eliminate the odors, but an increase to 8-12 lb. did, so long as the treatment was under complete control and residuals were kept within reason.

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plication of the chlorine dioxide from the point of pre-chlorination to the beginning of the mixing chamber, using 7½ ppm of both sodium chlorite and chlorine, pre-chlorinating to the raw wells at 7 to 13 pounds per mg. We controlled the treatment by taking residuals hourly of the raw water before the point of chlorine dioxide treatment, at the beginning of the mixing chamber after addition of chlorine dioxide, of settled water on top of the filters, filtered water collector, and laboratory tap. Tap residuals were held at approximately 0.5 ppm; if they exceeded 0.55 ppm the nitrogen tri-chloride odors appeared, on which the chlorine dioxide had no effect, but it did control the algae odors if used in the proper amounts.

During the second week in August, large amounts of daphnia and cyclops appeared, which it required 3 ppm of chlorine to kill. This increased the tap residuals, but this was remedied by feeding carbon to the top of the filters after each wash, using an average dose of 7 lb. per mg, the rate being regulated by the tap residuals. This enabled us to produce a very palatable water, even at 79° temperature. The higher temperatures required 6 to 8 lb. more chlorine than the lower ones of about 52°. At this time we were prechlorinating at 7½ to 16 lb. per mg, and feeding sodium chlorite at 7½ lb. and chlorine at 6½ to 7. (Lower chlorine dosages did not effect perfect generation of the chlorine dioxide although the theoretical proportion is 4 to 1.)

Asterionella can be controlled by a dosage of 1 ppm and Anabaena reuire 1.5 ppm; the *count* of algae having no effect on the dosage required. The University of Michigan in cooperation with the Mathieson Chemical Corp. is studying this subject, and it is hoped that before long we will be able only to use the miscroscope to determine the proper dosage of chlorine dioxide. As yet there is no way of measuring the amount of chlorine dioxide other than the usual OTA method, it showing as a flash residual along with the free chlorine present

Experiences With Filtered River Water

M. M. GIBBONS
Supt., Board of Water Commissioners

THE Rahway, New Jersey, municipal water supply, a filtered river water supply of 6 mgd capacity, was subject to occasional objectionable taste and odors due to upstream vegetation growth and also to industrial contamination. Chlorine dioxide treatment has been used for about two years in an attempt to improve the water quality.

We used an existing Wallace and Tiernan vacuum type chlorinator to feed chlorine water to the chlorine dioxide generator and purchased a Wallace and Tiernan solution feeder to pump sodium chlorite solution to the generator, a closed glass cylinder filled with inert lumps. The two solutions mix in the generator and form chlorine dioxide which feeds into our filtered water containing a chlorine residual of 0.1 to 0.2 ppm.

The treatment has not proved to be a panacea for all our taste and odor troubles, but has had some beneficial results. It has improved the taste and odor of the water when algae or other vegetation growth was the source of the difficulty. It also appears to be beneficial when certain medicinal odors are present in the filtered water. It has had no beneficial effect when a spill of petroleum waste contaminated the river water. We occasionally have complaints of chlorinous odors when the residual chlorine through the filters is high. We have also had a few occasions when a woody, musty odor of indefinable origin was present despite the treatment.

The chlorine dioxide treatment appears to be selective in its action, just as is activated carbon which we frequently use in conjunction with it. Sometimes neither of these treatments in a practical range of dosage will produce a water free from consumer complaint. Our average dosage of sodium chloride in 1947 was 2.8 lb. per million gallons, costing $2.10 per mg. The post-chlorine dosage averaged 1.7 lb. per million gallons, costing $0.16 per mg. The chlorine dioxide treatment thus cost an average of $2.26 per mg during 1947. In addition to this, our prechlorine dosage averaged 15.3 lb. per million gallons and cost $1.42 per mg. Our activated carbon dosage averaged 22 lbs. per million gallons and cost $1.82 per mg.

It may well happen that we shall learn how to use chlorine dioxide treatment more effectively in the future. In an empirical process such as the removal of objectionable taste and odor from water, time is a most important element. Meanwhile, we regard the results as sufficiently promising to warrant a more extended trial.

Chloro-Phenol Tastes Removed

WM. U. GALLAHER
Plant Superintendent

CHLORINE dioxide is used at Appleton, Wis., for the control of chloro-phenol tastes caused by the discharge into the river of phenolic compounds at Neenah and Menasha at irregular intervals. For a long time ammonia was used along with the chlorine in the raw water, but at times this did not entirely eliminate the chloro-phenol tastes. Moreover, the coli concentration of the river water has increased greatly in recent years and more efficient action of the chlorine was desired. We tried the chlorine dioxide treatment and find that it removes the chloro-phenol tastes very efficiently, no matter how intense they are. However, it is not very effective in the removal of algae tastes and odors, and therefore we continue to use large amounts of carbon during the summer months.

We use from 1 to 2 lb. of sodium chlorite per million gallons. The sodium chlorite is dissolved in a 30-gal. earthenware crock, fed by means of a Proportioneers heavy-duty midget chloro-feeder, and the solution mixed with chlorine in a Mathieson Alkali Co. glass generator.

The removal of chloro-phenol tastes by chlorine dioxide is miraculous. Chloro-phenol tastes are not caused by chlorine at all times, but we feed ClO_2 continuously as a precaution.

Good Results at Manheim, Pa.

CHARLES M. GEIB

OUR water supply is taken from Reiff's Run, a small stream having its source in a gravel formation. The water from this stream flows by gravity into two settling basins. Since this is surface water we have a certain amount of odor and taste, and to eliminate this we are using chlorine dioxide with very good results.

Zoological Dozers

First it was bulldozers—later the heroes of World War II. A few years ago "cow dozers" were announced, and we suggested editorially that "calf dozers" might be next in order. And sure enough, a few

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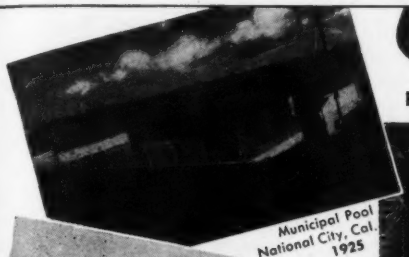
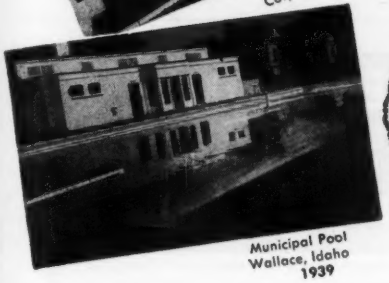


Municipal Pool
National City, Cal.
1925

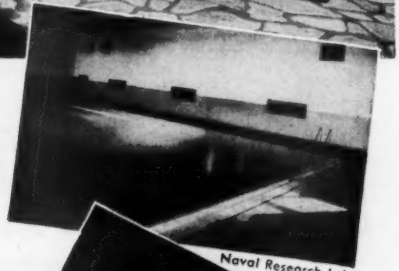
Arizona Biltmore
Phoenix, Arizona
1936

Country Club
Corpus Christi, Tex.
1938

Private Pool, Los Angeles, California
1936



Municipal Pool
Wallace, Idaho
1939



Naval Research Laboratory
Washington, D. C.
1943

Marine Recuperation Center
Klamath Falls, Oregon
1944

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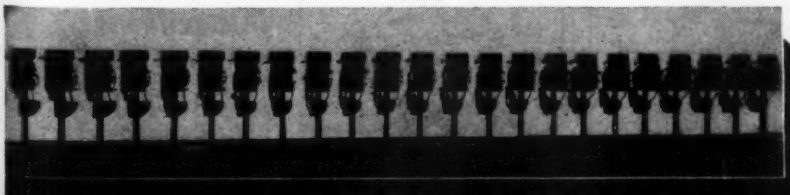

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months later an English contemporary announced the arrival in that country of the calf dozer, many of which are now in use over there. And a January issue of an English journal contains a picture of a "*Muledozer* at work at a refuse tip." The description is inadequate, but from the photograph we judge it is similar to one of the recent developments in this country called "dozer shovel," pay loader," "scoopmobile," etc. We wonder what other member of the animal kingdom we will next find dozing.

Small Sewage Treatment Plants

(Continued from page 27)

necessity for the use of such special controls should be taken by the authorities as a signal that the plant is overloaded and steps should be taken to provide additional capacity.

Industrial Wastes

Just as with other conventional processes, the "Pakage" plant is capable of handling a wide variety of industrial wastes providing sufficient capacity has been incorporated in the design to meet an existing load, or capacity is added to meet a new load. Obviously, the volume, strength and character of the waste must be determined within an approximate range since there is no generalization of the handling of industrial wastes. The mechanics of the treatment units must be designed individually for each type of waste regardless of the process used. If the load increases, the size of the plant may be readily increased to treat such increased loads as are caused by the location of a new industry or the increase in size of an existing industry after the sewage plant has been constructed.

In some cases, depending upon the ratio of industrial wastes, preliminary settling or holding tanks should be utilized at the source for economy and effectiveness of treatment.

Operation Results

As an indication of the ability of these plants to handle industrial loads the following typical examples are cited:

The "Pakage" plant at Sandwich, Illinois, is handling wastes from a creamery and from an ice cream factory, in addition to the domestic sewage. This plant is located in a town of about 2,600 people. The plant consists of comminutors, primary settling tank, two aerator-clarifier units and separate sludge digestion. The operator of this plant also runs the municipal water works. During 1946 the average daily flow at the plant was 0.169 mgd. Plant records show that the average BOD of the raw sewage during 1946 was 610 ppm., that the BOD in the final was 44 ppm., and that the average reduction in BOD from raw to final was 93 per cent.

Another example of a plant handling industrial wastes effectively and economically is at Ladd, Illinois. This plant is located in a town of about 1,200 people in the coal mining district of Illinois. Both milk wastes and wine wastes are treated here. The plant has produced a final BOD of 7 ppm. with a raw sewage of 246 ppm.

At Newton, N. C., one of these plants is treating dye wastes combined with the domestic sewage of the community. While the color of the dye is not entirely removed, tests show the treatment is effective.

These plants are typical of other installations located in various parts of the country treating industrial wastes in addition to the domestic sewage of the community.

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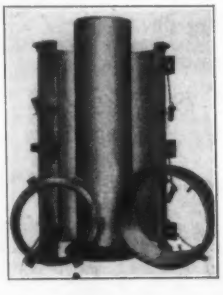

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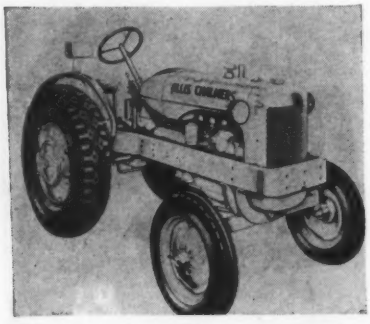
Municipal Model Wheel Tractor

Allis-Chalmers announces production of a new wheel tractor designed for municipal and industrial maintenance and featuring many improvements over pre-war models. Particularly useful for



Wheel tractor adaptable to many municipal jobs.

public works service, this unit provides easy mounting for a wide assortment of useful tools such as mowers, snow plows, hoists and brooms. It is claimed that the 16.3 HP. water cooled gasoline engine used less than one gallon of fuel per hour of average work. This easy handling tractor weighs 2365 lbs. and has a 57½" wheelbase. Write *Allis-Chalmers Mfg. Co., Tractor Division, Milwaukee 1, Wisc.*

Protecting Concrete Surfaces

This is a synthetic paint that protects concrete surfaces with a coating that does not check, chip or peel. It seals concrete against moisture, drying in 3 to 4 hours. It is suitable for traffic markings and will withstand very heavy wear; it is resistant to corrosive acids, is immune to alkali, and withstands heat up to 500°F. For fuller data on how to use, write *Lowebco, Inc., Chicago, Ill.*

Mist blower for insecticides and weed control.

One-Third Less Reinforcing Steel

This new type of reinforcing bar permits a saving, according to the makers, of one-third in the weight of steel, with accompanying savings in costs of handling, placing and bending. Production methods increase the yield point 50% and the shape assures a very high bond strength. Write for Engineering Data Book, *Wehrib Steel Corp., Dept. PW, 120 Broadway, New York 5, N. Y.*

This new reinforcing bar permits saving in steel.

A Transit-Level With Many Advantages

This instrument can be used for levels and for lines and grades. It has a 22x scope, which focuses as close as 4 ft., and it is not necessary to remove the scope from the standards for either levels or lines. It has a vertical arc; the vernier reads to 1 minute; the vertical range is very high—110°; the telescope level has a sensitivity of 60 seconds. This and other transits and levels are described in a new 56-page catalog available from *Warren-Knight Co., 136 North 12th St., Philadelphia 7, Pa.*

Weed and Insect Spray Unit

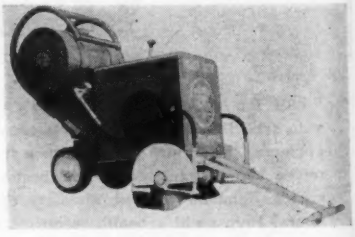
A wheelbarrow model mist blower, insures thorough mixing and effective application by a motor driven blower and a new type nozzle. The "Guptill Whirlwind" is said to project a mist laden air stream 30 to 40 feet vertically in still air, and to produce a mist which will carry up to 500 feet with the wind. Handle controls permit the operator to change the direction of the spray as he moves along. *Write Fitzhenry-Guptill Co., Dept. PW, 135 First Street, Cambridge, Mass. for further information.*

All-Wheel Drives for 1948 Ford Trucks

All-wheel drive conversions for the 1948 Ford motor trucks have been announced by *Marmon-Herrington Co., Inc., Indianapolis, Ind.* By placing driving power on the front wheels, as well as in the rear, the tractive ability in mud, sand and snow is greatly increased.

Fine for the Water or Sewage Plant

This is a light power mower which should be fine for keeping the grounds at the sewage plant or at the water works in good shape. It can also be used for golf courses, parks and lawns, but is too light for roadside mowing. *Lawn Mower Division, Reo Motors, Lansing, Mich.*



Diamond wheel cutter for concrete.

Concrete Cutter Helps in Street Repairs

This diamond wheel concrete cutter will cut pavement of all kinds for trenches, weakened plane joints, curbs, ramps, etc. It has a 10 hp. engine and will cut to a maximum depth of 6½ ins. The manufacturer claims a 40% to 50% saving in concrete removal by first cutting an outline of the area to be removed and an overall saving of 60% in cost. Full data from Dept. PW, *Felker Mfg. Co., Torrance, Calif.*

GMC COE Trucks

Cab over engine trucks are now in production by General Motors. There are five FF-350 models, with wheel-

MENT

bases ranging from 122 to 197 ins., and with gross vehicle weight ratings of 16,000 to 26,000 pounds; and five models of the FF-450 series. The latter have the same length wheelbases, but are in heavier weights. *GMC Truck & Coach Division, Detroit, Mich.*

A Gravel and Dirt Road Maintainer

This is a FWD truck especially designed for use with an under-truck maintainer, with mobility to handle widely separated maintenance jobs on gravel and dirt roads. The truck is high enough to accommodate any underbody maintenance blade. It has a gross rating of 20,000 lbs. In addition to suitability for maintenance work, it is, of course, adaptable to hauling, snow removal, etc. *FWD Auto Co., Clintonville, Wisc.*

Cedarapids Crushing and Screening Plant

This new portable crushing and screening plant, in which the crushing is handled by a cone crusher, is used for secondary crushing of rock or gravel where the material being fed is fairly uniform in size and requires a reduction of only one or two sizes, and where fines are not particularly desired. It is available with either steel wheels or pneumatic tires. *Iowa Mfg. Co. Cedar Rapids, Iowa.*

2-Wheel Hydraulic Scrapers for Highway Work

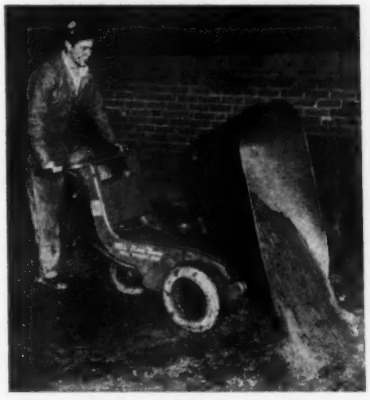
Designed for use with fast industrial type rubber tired tractors, these scrapers (630 and 750) have heaped bowl capacities of 3.2 and 5.4 yards. They should be of exceptional value on small highway jobs. They cut, lift, dump and spread under precise control of the operator. Also, they can be loaded by shovel or dragline, if desired. These Be-Ge units are described fully in booklets available from *Be-Ge Manufacturing Co., PW Dept., Gilroy, Calif.*

Truck Crane Features Remote Control

To make pile driving faster and easier the new P & H truck crane provides carrier operating controls located in the crane cab. All normal carrier operations, steering, shifting, starting and stopping are controlled by simple push buttons. Independent engines provide for travel and crane service. The all-welded crane features independent planetary boom hoist and planetary load lowering. *Harnischfeger Corporation, 4400 W. National Ave., Milwaukee 14, Wisc.*

A Money-Saving Materials Carrier

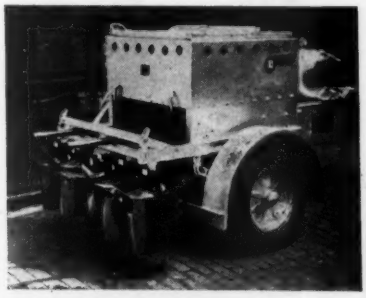
Bell Aircraft engineers have emancipated the wheelbarrow by mounting a high-capacity, mechanically dumping barrow on a strong, power-driven 3-wheel chassis. Public Works men will find many uses for this "prime mover," termed by the makers the "one-man, half-ton mover that goes anywhere with anything." The 10 cu. ft. bucket can be replaced quickly with a platform body. For heavy duty service dual wheels with chains are available. A 50" snow plow attachment is also available. Engine speed is controlled with a fingertip throttle; speed is limited to a fast walking pace for safety and economy. Loaded or unloaded, the center of gravity remains low. *Bell Aircraft Corp., Box 1, Buffalo, N. Y.*, will supply full information.



One-man, half-ton materials mover with 10 cu. ft. bucket.

A light, fast hydraulic scraper for highway work.

PUBLIC WORKS Equipment News



Tool heating trailer unit.

Improved Tool Heater Unit

The new Littleford unit shown in the accompanying photo is equipped with automotive type springs and pneumatic tires. The heating compartment contains ribbed cast iron liners on bottom and sides to facilitate sliding of tools and allow heat to circulate easily. Directly above the tool heating compartment is a grill for heating pouring pots and buckets. Another model has in addition a 50-gallon kettle which may be heated along with the tools or insulated by cast iron liners. Write to *Littleford Bros., Inc., 443 Pearl St., Cincinnati 2, Ohio.*

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Please send me more details about the following new equipment described in your May issue. (Give name of product below.)

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(See also pages 44 and 76 for more data)

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Extension Stems
Mud Valves
Flap Valves
Sludge Shoes

M & H VALVE
AND FITTINGS COMPANY
ANNISTON, ALABAMA

PUBLIC WORKS Equipment News

(Continued from page 43)

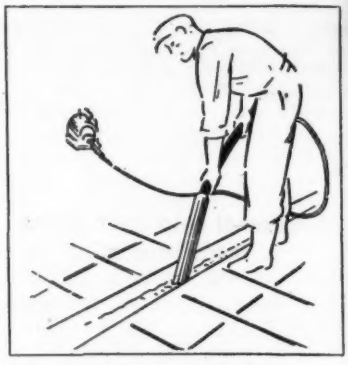
Ditchers With Three-Position Booms

Two new ditchers recently added to the Barber-Greene line have booms which are quickly adjustable to left, center or right to permit digging close to obstacles. The vertical boom cuts straight down, leaving no ramp; buckets are self-cleaning. Model 720 digs trenches 8" to 11" wide and up to 4 feet in depth at speeds up to 32 feet per minute. Model 710 cuts trenches 5½" wide and 42" deep. An added attachment of this model feeds cable into the trench and plows over the spoil in one continuous pass. Both models are equipped with overload releases, and hydraulic hoists for booms. Full data from *Barber-Greene Co., Dept. PW, Aurora, Ill.*

Barber-Greene model 720 ditcher with adjustable-position vertical cutting boom.

Faster Lightweight Pumps

Faster automatic priming, priming at higher suction lift, and higher pressures, capacities and efficiency are features claimed in the Gorman-Rupp line of lightweight, self-priming centrifugal pumps. The accompanying illustration shows, right to left, the Midget, Hawk and Eagle models, with capacities of 86, 156 and 280 gpm. respectively, at 30-foot head. The Midget weighs only 62 pounds complete with 1½ HP. engine. Other models weigh 110 and 117 pounds. For full data on these lightweight pumps write for Bulletin 7-LW-13. Address the *Gorman-Rupp Co., Dept. PW, Mansfield, Ohio.*

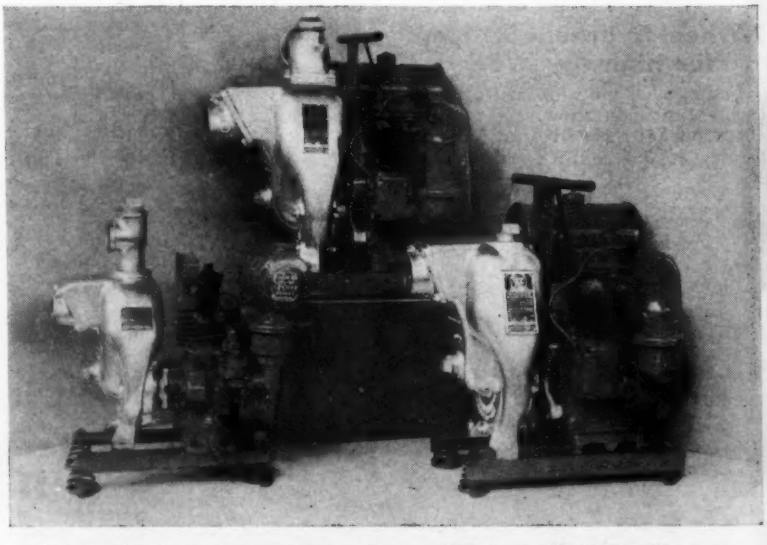


The Vibro-Plus vibrator.

High Frequency Vibration for Better Concrete

Internal vibrators with 13,000 vpm are made possible by a patented design of the vibrator head, producing the high frequency with a flexible shaft speed of only 3,000 rpm. Total weight of these units is 112 to 119 pounds. They are especially adapted to the construction of walls, pillars, columns, girders and heavy beams. The usual procedures for vibration are employed. Further information, and a technical booklet on concrete construction will be furnished on request to *Vibro-Plus Corp., Dept. P, 243 West 55th St., New York 19, N. Y.*

More descriptions on page 76



Left to right, the Gorman-Rupp Midget, Hawk and Eagle portable lightweight pumps.

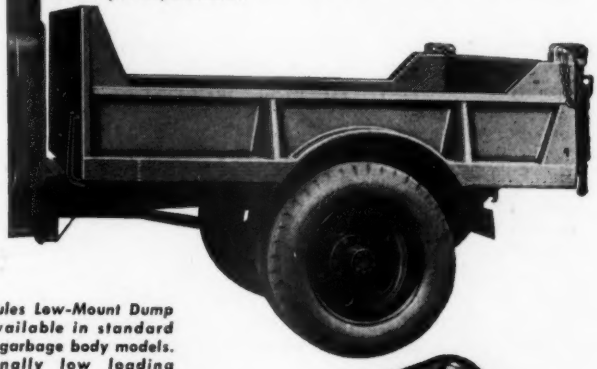
HERCULES HYDRAULIC HOISTS AND DUMP BODIES

DESIGNED and BUILT TO DO THE JOB

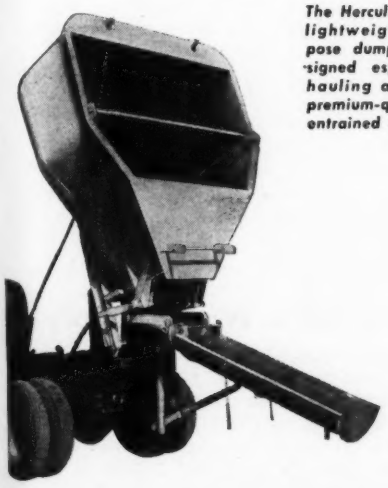
Dependable, economical performance—that's what you need to make dump truck operation profitable. And that's the kind of performance built right into Hercules Hydraulic "Center-Lift" Hoists and Dump Bodies. Every Hercules unit is designed for a specific job, and built to do that job in less time, at lower cost.

Hercules engineering experience and precision craftsmanship have been combined to produce powerful, efficient "Center-Lift" hoists and rugged, built-for-service dump bodies. Wherever there's a difficult hauling and dumping assignment, you'll find Hercules equipment, turning in the steady, maintenance-free performance that means profitable operation. If that's the kind of performance you're looking for, you'll want to know more about Hercules Hoists and Dump Bodies. Specifications and data on the complete Hercules line available without obligation; write today, outlining your requirements.

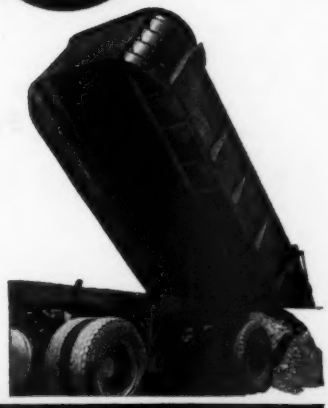
Hercules Contractor's Body, Model D-12, sturdy, all-around unit for heavy-duty service. Pyramid type enclosed steel side braces. Available in a wide range of capacities to meet individual job requirements.



The Hercules Low-Mount Dump Body, available in standard dump or garbage body models. Exceptionally low loading height of this unit saves time and labor on all manual loading jobs.



The Hercules Aircreter, lightweight, all-purpose dump body designed especially for hauling and placing premium-quality, air-entrained concrete.



Hercules Heavy-Duty Dump Bodies for semi-trailer mounting. Suitable for use on straight or drop-frame trailers. Straight and round-nosed models.

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PUBLIC WORKS

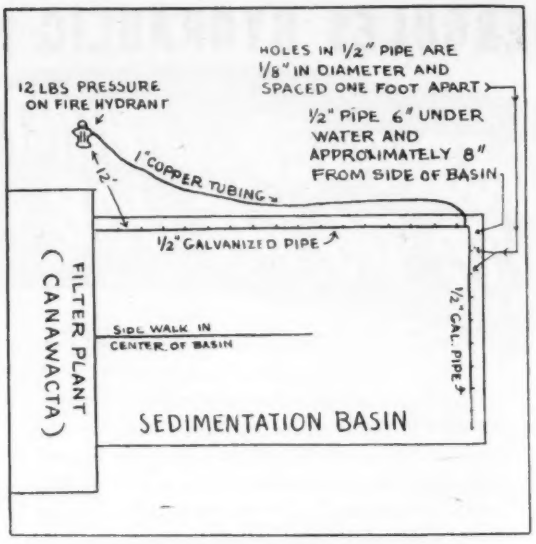
Engineering Data

Preventing Ice On Sedimentation Basin Walls

Like many other water purification plants in cold climates, that at Susquehanna, Pa., where the thermometer drops to 20° or more below, has been troubled with ice formation along the sides of its settling basin. During the winter of 1947-48 they devised a method of preventing this that appeared to be satisfactory. The general theory was that water would not freeze if the surface was kept in a state of violent agitation.

Testing with a garden hose submerged with the nozzle a little below the surface having proved the correctness of this, they installed 82 ft. of ½" pipe, with ⅛" holes drilled at one foot intervals, about 8" from the sides of the basin and 6" below the surface. This is connected to a fire hydrant on which the pressure is 12 lb. This kept unfrozen a path 6" to 12" wide above the pipe, with the temperature as low as 22° below zero. It uses about 20,000 to 25,000 gal. of water per 24 hr. They expect to reduce this by reducing the size of holes in the pipe and connecting the feed line to the submerged line in a number of places.

The idea was suggested by M. E. Flentje, research engineer of the American Water Works Co. (which owns the plant) and the details were worked out by Willard Westcott, filter operator, and Dominic Battisti, utility man. John Storer is manager of the plant.


HOLES IN ½" PIPE ARE ⅛" IN DIAMETER AND SPACED ONE FOOT APART
12 LBS PRESSURE ON FIRE HYDRANT
½" PIPE 6" UNDER WATER AND APPROXIMATELY 8" FROM SIDE OF BASIN
1" COPPER TUBING
12"
½" GALVANIZED PIPE
FILTER PLANT (CANAWACTA)
SIDE WALK IN CENTER OF BASIN
½" GAL. PIPE
SEDIMENTATION BASIN

Hook-up for preventing ice formation.

Finding a Gas Leak Into a Sewer System

Salem, Ill., had two sewer explosions in the fall of 1947, one when someone tossed a match into the sewer at the comminutor, and another in the boiler room of a garage. The first was extinguished without much damage. The second blew up a couple of manholes. Careful investigation showed no definite origin of the gas or pattern of concentration. With the help of the State Fire Marshal's coal mine inspectors, the whole sewer system was investigated. By means of a rubber gasketed board, sections of the sewer system were isolated and a gas indicator used to determine the presence of gas. A leak in the gas distribution system was located at a point where a newly laid sewer paralleled a gas main. After this leak was repaired, gases were still detected in the sewers, so the work of blocking off and testing sections of the system was continued. Another leak was then found on the opposite side of the city. Following the repair of this leak, the sewers soon cleared. Both leaks were more than half a mile from the treatment plant, but the concentrations of gas were greatest at the plant. The gas was propane, which is heavier than air and will not flow out of manholes. W. M. Reese is Utilities Superintendent at Salem, and the above data are from *The Digester*, publication of the State Department of Health, of which C. W. Klassen is Chief Sanitary Engineer.

Stabilizing 3,000 Ft. of Road Per Day

On a recently completed road in Lauderdale Co., Mississippi, the daily production rate was approximately 3,000 ft. This was a soil-bituminous road, 10.5 miles long and 22 ft. wide, which was processed to a depth of 6 ins., compacted. The soil was A-2 classification with PI of 5 or less and clay with a PI of 19, combined with sand to produce A-2 material. The stabilizing agent was asphalt, RC-2, using 4.32 gallons per square yard, equal to 7% by weight of the dry soil. A P & H single pass soil stabilizer was used. Traffic was maintained on the road during construction.

A Flight Strip for a Water Supply

A flight strip will be used to divert rain water into underground catch basins to provide a drinking water supply for the Island of St. Thomas, Virgin Islands. The project also calls for a water treatment plant, water supply and distribution system. The proposed flight strip will be 4,500 ft. long and 200 ft. wide. Robert L. Kenan & Associates, Montgomery, Ala., is the engineer. This project is reminiscent of one early in the recent war, when only water very high in chlorides was available for U. S. troops on one of the Caribbean islands. The servicing area of the airfield was blocked off, and the runways were then used for rainwater catchment. The 40 acres of runways saved construction of a similar catchment area estimated to cost $700,000. The probability of lead contamination was considered, both analytically and by test. Rainwater was collected from the servicing areas of busy airports in Washington and Chicago, and analyzed to

SAVED $199,000 IN SIX YEARS!

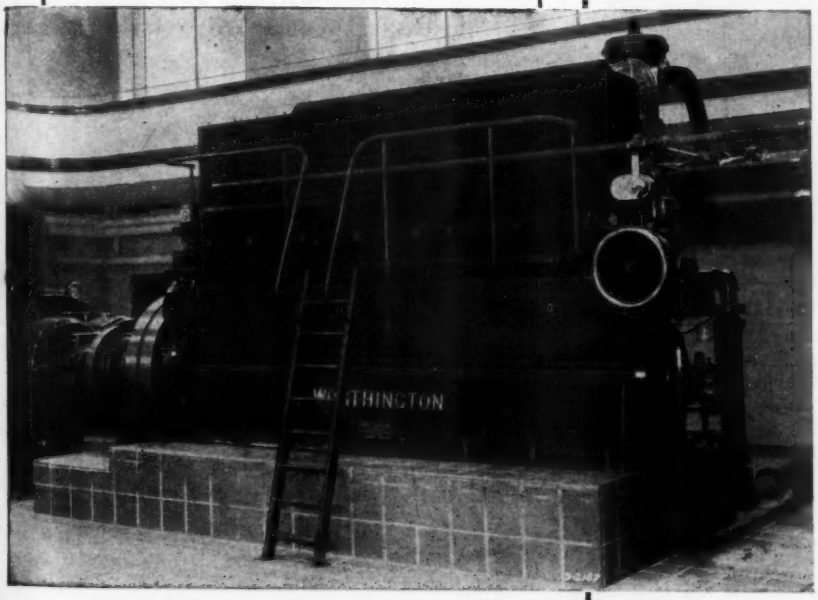
Worthington Gas Engine In Fort Wayne's Sewage Disposal Plant Has Paid For Itself Many Times Over

An important factor in Fort Wayne's improved health rate, the city's Sewage Disposal Plant has gained nation-wide recognition for its progressive design and operation.

Heart of the installation is a Worthington Gas Engine, operating on sewage gas. Direct-connected to a blower, the unit is on continuous heavy duty. In 1946, for example, the *daily average* was 14.65 million cubic feet of air pumped into 18.73 million gallons of sewage.

A Real Pay-Off!

Savings earned by this Worthington Gas Engine during its first six years of service have been enormous. The cost of outside electric power to do the same amount of work would have been many times the engine's original purchase price! In addition, water from the engine's cooling jacket is used to heat the sludge digesters. In 1946 alone, nine billion BTU's were so utilized — the equivalent of 650 tons of coal!



Worthington Gas Engine—Type CCG-7, 465 hp—in the Sewage Disposal Plant, Fort Wayne, Texas. Besides driving a blower, the unit heats sludge digesters with water from the cooling jacket.

To Cut YOUR Power Costs

Worthington offers a wide range of Engines for sewage plant service — including the famous Dual Fuel Diesels that operate on gas, oil, or gas-and-oil in any ratio. For further information proving *there's more worth in Worthington*, write to *Worthington Pump and Machinery Corporation, Engine Division, Buffalo, N. Y.*

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Evaporative Type Engine Water Cooler

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But chemical plants are not alone in such preference. Check the hundreds of cities, railroads, packing houses, tire manufacturers, steel mills, petroleum refineries, army camps, naval stations, big air conditioning and irrigation projects—in fact almost every big well water user in the United States, Canada and Mexico. There too, you will find almost exclusive use of the world famous Layne Well Water Systems. Such uncontested leadership is ample proof of superiority. For literature, address Layne & Bowler, Inc., General Offices, Memphis 8, Tennessee.

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determine its lead content. The analyses showed an exceedingly small absorption of lead. Coagulation and filtration, with chlorination, was also provided, thus increasing the factor of safety, since such treatment processes reduce the lead content of water.

Sawing Concrete for Patching

In patching its concrete pavements, Arkansas highway department uses a saw to make an initial cut outlining the part of the pavement to be renewed, then breaks out the concrete within this area. This gives a 2½ vertical edge to patch against, with sound concrete up to the patch, which is made uniformly 9" thick. The cutting wheel of the saw is 1 ft. in diameter with a rim containing small commercial diamonds set in brass or copper. It is driven by a hand-propelled, power operated machine.

This disk costs $65 and lasts for an average of 360 ft. of cut. Including the operator and operating expenses, it costs about 25 cents per ft. in Arkansas to make the original cut.

The concrete is vibrated with a portable speed vibrator run by two men.

A 10-Million Gallon Welded Steel Reservoir

The accompanying view shows the 10,000,000 gal. welded steel reservoir built by the Chicago Bridge & Iron Co. for the Washington Suburban Sanitary Commission at Carmody Hills, Md. This structure is 292 feet in diameter and 21 ft. high.

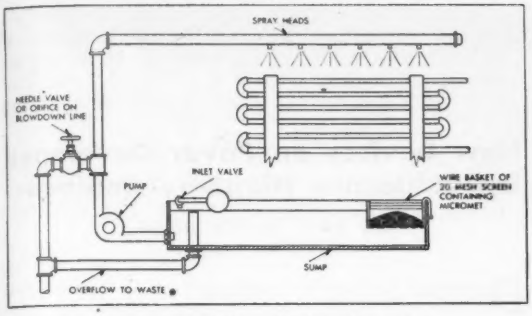
10 million gallon welded steel reservoir.

Radar and the Proximity Fuse for Rat Traps

A combination of radar and the proximity fuse is now available to get the better of *Rattus*. The box-like trap is set along a rat runway. When the rat enters the tunnel, the proximity fuse shuts the doors of the trap; then radar goes to work and kills the rat instantaneously, without any burning or singeing. As soon as the rat is dead, more machinery goes to work to eject rattus defunctus, and open the doors, ready for the next victim. This extremely interesting device was worked out by John O'Brien, an electrical engineer of Norfolk Place, Rochester, N. Y.

Solving Scale Troubles in Diesel Cooling Water

The municipal power system at North Branch, Minn., L. E. Madsen, Superintendent, had trouble with scale in the cooling water system of the diesel engines. Local water has a hardness of 17 gpg. The use of micromet, one of the polyphosphates, solved the problem. The chemical was placed in a basket in a cooler



Chemical feed layout at North Branch.

sump, and allowed to dissolve. The layout is shown in the accompanying sketch. Due to the evaporation of the water used for cooling, some blowdown or wastage is necessary to prevent an excessive concentration of salts in the cooling water. On the basis of conditions at North Branch, it was determined that twice as much water had to be wasted as was evaporated; and based on the volume of make-up water, treatment required an initial charge of 4 pounds of micromet and a monthly recharge of one pound.

Inconclusive Results With Chlorine Dioxide at Toledo, Ohio

A. L. KRUGER
Supt. of Filtration

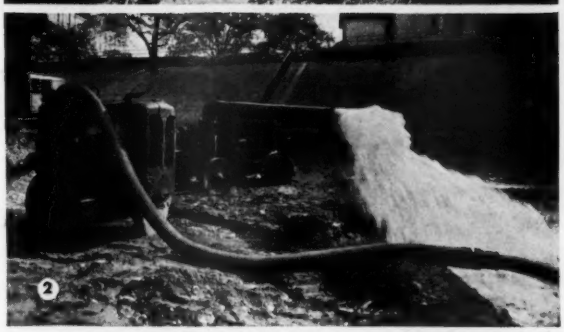
TOLEDO'S most serious taste and odor problems are caused by the blue-green types of algae, chiefly Anabaena, which are present in the water during late August, September and part of October. In 1946, when heavy concentrations of these organisms caused severe taste and odor problems, chlorine dioxide was used. We were advised that a treatment of two pounds per mg of sodium chlorite would be sufficient to eliminate these tastes and odors, and a pump with capacity sufficient to deliver chlorite solution for that dosage was installed and put into operation Sept. 18th, but there was no reduction of the taste and odor intensity for the remainder of that season.

Whether a higher dosage of chlorine dioxide would be effective we cannot say, because the algae diminished before additional installations could be made that year, and concentrations of algae since 1946 have not been heavy enough to warrant another trial. (See other articles on pp. 35, 36, and 38. Ed.)

Underwater Lighting for New Cincinnati Pool

Underwater marine lighting and a 7-ft wall to provide shelter from wind are two of the features of a new swimming pool at Cincinnati, O. The dimensions are 75 ft. by 175 ft. Foundations and perimeter walls are provided so that the pool may be covered, if desired, in the future. The wall is designed to minimize air currents which may make night swimming uncomfortable. Locker and dressing rooms are underground, affording additional space around the pool. Because the pool is located near an industrial area and the air contains considerable soot, the filtration system is oversize, providing a turnover period of 5 to 5½ hours. Chlorine is applied so as to maintain a residual of

here's Low Cost dewatering



1. This contractor was able to lay telephone conduit in a river bed behind a row of easily portable Jaeger pumps and simple drainage lines . . .

2. This low-cost system was practical because his Jaeger pumps primed quickly and unfailingly as soon as water sealed the intake and had the big capacity needed to keep the trench pumped out.

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0.3 to 0.5 ppm. All piping is galvanized wrought iron, which is resistant to corrosion. Wayne A. Becker of Cincinnati was consulting engineer and F. W. Garber architect on the pool.

New Devices on Paver Developed by California Highway Engineers

By EARL WITHYCOMBE
Construction Engineer

DIFFICULTY is often experienced in maintaining a true line to the spread on nearly every surfacing job where the Adnun paver is used for the first time. On the project on U. S. 466, Resident Engineer C. G. Gates of the California Highway Division, in cooperation with the contractor, Basich Brothers, worked out means of overcoming this difficulty.

A 3 inch x 3-inch x 12-foot length of ¼-inch angle iron was welded to the frame of the paver on the operator's side, so that it projected about 6 feet beyond the front wheels. To this was welded another section of angle, back to back, to give rigidity. An adjustable rod with set screw was fitted through a pipe guide at the forward end of the channel projecting out over the shoulder and a vertical pointer suspended from the end from which to measure position from the previously stretched chalk line.

Difficulty was experienced in properly spotting variable width trucks. Some were so wide that there was little clearance between the rear tires of the truck and the steering wheels of the Adnun. To remedy this a stick with a weighted string was fastened to the front bumper of the truck from a previously placed mark each time it backed into the paver. With some experience on the part of the truck driver this could later be discontinued without experiencing any difficulty.

On this project, as with nearly every other paving job where self-propelled spreading and finishing equipment is used, it was found desirable to chain each truck to the paver with a single chain hooked to the front bumper of the truck. In cooperation with *California Highways and Public Works.*

City Problems in Annexation

Five tracts are seeking annexation to Seattle, Wash. These range from a few city blocks to five square miles in area, and aggregate nearly eight square miles or 10 per cent of the total present area of the city. Annexation of these areas would increase municipal expense by from $800,000 to $1,000,000 a year. The Seattle engineering department estimates that the cost of supplying municipal services would amount to $100,000 per square mile, not including the cost of parks, library and health service, and overhead expense. Revenue to the city of Seattle from property taxes and per capita state grants would total $60,000 per square mile from this district. Annexation would result in more taxes for citizens of these areas but they would receive police, fire, health, street lighting, garbage, library, and park facilities and services; and would not have to pay the 33% extra suburban water charge levied by the city; fire insurance premiums would be reduced; and the present $1 monthly garbage collection charge would be eliminated. These factors are being considered by the Seattle city council and are reviewed in a report *Annexation—Is It Good or Bad?*, issued by the Seattle Municipal League.

PUBLIC WORKS DIGESTS

Sewerage

Water Supply

Highways and Airports

This section digests and briefs the important articles appearing in the periodicals that reached this office prior to the 15th of the previous month. Appended are Bibliographies of the principal articles, in which the articles in each periodical are numbered consecutively throughout the year, beginning with our January issue.

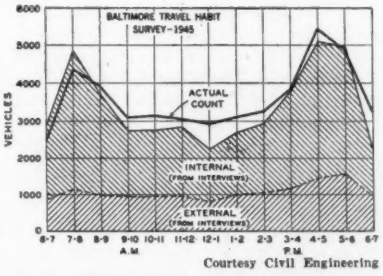
The letter and number at the end of each item refer to those used in the Bibliography. Numbers not found in the current Bibliography will be found in the one published the previous month.

The Highway and Airport Digest

Traffic Engineering

Traffic engineering has advanced rapidly from an art to a science, even though it involves the highly variable human element which makes fixed values and treatments difficult. The application of engineering techniques to traffic makes traffic engineering the only strictly factual approach to traffic problems.

Among the valuable things learned recently is that people approaching cities by auto want to go into them, not around them, establishing the value of traffic origin and destination surveys. The traffic engineer should provide the technical answers to traffic problems through research, surveys and studies. Regulations must be modernized without the influence of whims, politics, and personal ambitions; control devices should be made uniform and fitted to traffic needs; traffic facts must be collected and applied to the design and planning of new routes; and many cooperative activities must be pushed forward through traffic engineering techniques.[L9]



Courtesy Civil Engineering

New traffic survey techniques check closely with actual count.

Sidewalk Snow Clearing

Of 16 Canadian cities replying to a questionnaire (more replies are expected), all but 3 remove snow from sidewalks as a public undertaking; and of these 3, Vancouver and Victoria, B.C., have little snow; the latter has not taken its snow plows out of the yard for 20 years. Four of the cities require owners in the business areas to clean their sidewalks themselves. The mileages cleared range from 17 by Yorkton, Sask., to 1,000 by Montreal. The equipment used includes crawler type and wheel tractors, and horses, with V-type and one-way plows and with scrapers. Winnipeg uses 46 horse-drawn wooden plows, and 34 horse-drawn steel plows and planers, and 17 tractor-drawn plows. Edmonton has 4 plow-equipped jeeps.[O13]

Spraying Roadside Weeds

Roadside weeds not only affect appearance, snow drifting and drainage, but even more important is the fact that they are the main harboring places of many insect and fungi pests and even some virus diseases. For example, wild legumes harbor bean blight; mustards harbor cabbage black leg; prickly lettuce, bean and other thrips and leaf hoppers.

Most weeds have only one stage in their growth when spraying is economically practicable. This necessitates spraying according to a pre-determined program so as to catch each class of weeds at its critical time, which can be done by spraying three times—early, midsummer and fall. The program suggested is spray one-half of the roadsides early and late the first year and in midsummer of the third year; spraying the other half of the roadsides early and late in the second year and in midsummer of the fourth year. Following this, spray each half every second year, each spraying coming in a different month. In dividing the roadside into two parts, it is believed that the approval of the taxpayers can best be obtained by spraying one side of each road the first year and the other side the second. Thus each property owner can see the result in front of his own property, which result should be such as to make him want the other side sprayed the following year.

As to how much 2,4-D is required, the custom sprayers have adopted as a unit, pounds per 10-ft.-mile. A dosage of 1½ lb. per 10-ft. mile will kill off weeds that are sprayed at the correct time of the year; it will not kill weeds that have already gone to seed, and only a small percentage of those that are just breaking through the ground. The 2,4-D is absorbed by the top of a weed and slowly works down to the root, where it does its effective work. A strong dose may spectacularly kill the top growth before any of it reaches the root and the total result be less effective than half the dose at half the cost. For roadside work, the 2,4-D should be concentrated enough to involve no unnecessary haulage and handling of weight and bulk. We need to have in it added agents (1) to make it mix easily with water and stay mixed; (2) to cause it to spread over the leaves and not remain in drops; (3) to penetrate the layer of dust, oil and calcium chloride; (4) to give it the ability to absorb moisture from the air and stay active; and (5) to make it emulsify easily and stay in that state if it is to be used in an emulsion.

For applying, the best method is to combine the recommendations of the manufacturers of the equipment and of the chemical. For most work the pressure should not exceed 75 lb.; but the use of only 25 lb. and very fine nozzles does not seem to be suitable for roadside weeds with their heavy foliage and covering of dust. Adding calcium chloride, acids and other chemicals to 2,4-D necessitates care and full knowledge of the possibilities, as they may

develop dangerous poisons. No chemical, nothing short of soil sterilization, can clean up more than one-third of the weeds with one spraying.[O14]

Safety at Airports

Passenger fatalities in airplane travel were only 1.24 per 100 million passenger miles in 1946, the last year for which complete records are available. But many of these could have been avoided by better planning of the airports. Of the 73 accidents in 1945 and 1946, 44 occurred while attempting to land, while taxiing or while taking off. The most serious were those involving missed approach; to minimize which, runway width of 300 ft. and length of at least 6,000 ft. at sea level must be provided, plus a cleared, level, sodded area beyond the runway of as great an extent as possible. Overshot landings caused 11 crashes, which could probably have been avoided had the runways had the above dimensions; as could the undershot landings also. Two accidents were due to landing in water or slush, emphasizing the necessity or providing proper drainage. Other accidents have been caused by collisions at intersections of runways and of taxiways and by inadequate lighting.[P14]

Photographic Surveying And Highway Engineering

The use of photography for engineering purposes may be classified as (i.) Extraction of quantitative information, generally from air photography. (ii.) Use of air photographs for quantitative survey (air survey or photogrammetry). (iii.) Use of ground photographs for quantitative survey (terrestrial photogrammetry).

Freedom of action in ground surveying may be limited by dense woods, steep slopes, highly cultivated land, very private enclosures, etc., making such surveying tedious and costly. The risk of damage to agricultural produce and the premature disclosure of ultimate intention to acquire land in that it may cause embarrassment in later negotiations will often place the surveyor at a disadvantage.

The avoidance of severing valuable land so as to make it unprofitable is important. Detailed study of land utilization is a prerequisite. The accurate location of faults, slips, underground workings and unstable deposits of waste products requires careful attention. The choice of alignment is influenced by its possible effects upon land value. Experience shows that air photographs can record faithfully the most intimate detail of the manner in which land is worked, routes of access, water supply and drainage. Such photographs may be taken without calling attention to the fact that the survey is being done and will facilitate "round-the-table" conferences, saving many time-consuming visits to the site.

Ground photogrammetry has been applied in one way or another for a number of years, particularly in Switzerland and Canada, by means of photo-theodolites which are, in effect, a joint assembly of theodolite and precision camera with their optical axes on the same vertical plane when the instrument is levelled.

Short-base photogrammetry, by the use of two similar cameras set about four feet apart at each end of a bar and normal to its length, is of particular interest for close-range work. One type of equipment enables records to be made of structures, of traffic, of accidents, and so on. As a contribution to Road Safety the Swiss Police Department in a number of towns, have a special mobile-squad car equipped with a short-base pair of cameras.[D12 and Y1]

Reconstructing a Georgia Highway

In 1947, 23 miles of the Coastal Highway in Georgia, built about 1925, was improved by replacing badly damaged areas, widening from 18 to 24 ft., and surfacing with Topeka asphalt pavement Type 1. Where the old pavement was only somewhat cracked, it was not removed but the thickness of the new asphaltic base was increased to 3" or 4". In widening, 3 ft. was added on each side on tangents; but curves were spiralled and super-elevated, and on them most of the increased width was added on the inside of the curve. The superelevation was accomplished in most cases by increasing the thickness of the asphaltic concrete; but if this increase would amount to more than 12", the old pavement was removed and rebuilt with new concrete 7" thick. The 3 ft. widening strips were spread and finished with hand tools. At the outer edge of these strips a concrete header 6" wide and 2½" high was provided to prevent ravelling of the 2½" asphalt top applied on it. This top consisted of a 1½" binder and ¾" wearing course, the laying of the latter being kept about 5 miles behind the binder course. Finally the shoulder on each side was increased in width to 10 ft.[E9]

Electric Heating For Asphalt Plants

Heating the pipes, pumps and tanks used to distribute asphaltic cement to mixers in a paving plant is usually accomplished by use of steam; but this has several disadvantages, and because of these and of the high-class residential area in which it is located, where a steam plant would be objectionable, a plant built by New York City with a peak capacity of 120 tons an hour uses electric heating instead. The devices so heated include all asphaltic cement pipe lines with their fittings, valves and other appurtenances; asphalt-cement pumps, meters, strainers, tanks, spray bars; and the body of the mixers.

The asphalt is pumped to the plant through 4" steel pipe from barges. This pipe is heated by means of "Calrod" heating elements attached to the underside of the pipes, pipes and heaters being enclosed in a sheet metal cover, which in turn is surrounded with 2" asbestos insulation. The temperature is controlled by thermostats installed in the line. It takes 3 or 4 hours to heat a line before beginning to pump through it, but when the asphalt is flowing through it the electric heating is discontinued. For heating the tanks, the heat is transferred from the heating element through an enclosed body of air to a tube immersed in the tank, each of the five tanks containing 15 to 33 tubes. The three storage tanks can raise the temperature of a tank full of asphalt cement from 30° to 260° in 24 hr., and the two service tanks from 250° to 325° in 15 hr. To keep at a minimum the demand rate for the electric current (which is used for operating the plant as well as for heating), the plant is so operated that the electrical heating is done while most of the machinery is shut down, thus keeping the peak demand at that required for machinery operation.[E10]

Vibrating Screenings Into Macadam Bases

Ohio Dept. of Highways in 1947 tested vibratory placing of screenings in macadam bases as performed by two types of machine. One was an 8-ton tandem roller, with a third roll between the other two which is vibrated by an unbalanced shaft rotated at high speed within it. This was produced by the combined effort of the Buffalo-Springfield Roller Co. and the Pedershaab Machine Works of Denmark.

The other, produced by the International Vibration Co., consisted of a crawler-propelled frame which moved over the base a battery of six vibrating shoes, each with its own vibrating mechanism but all receiving power from the same source. Vibration was effected by twin opposed unbalanced gears on each shoe.

These machines were tried on five projects and demonstrated remarkable efficiency. It was possible completely to dry-fill the voids in a 10" compacted and keyed course of 3½-1½" stone with one application of more than 3" of dry screenings and three passes of the vibratory roller. In another job of 8" macadam, placed in two 4" courses, these were dry filled with three spreads of screenings and three passes of the vibratory shoe machine.[N28]

Why Contractors Lose Money

The percent of failures compared to the percent of successes in the contracting field is greater than in most other types of enterprises. This might seem to indicate that construction contracting is naturally an extremely hazardous undertaking. But errors made by contractors are the principal cause. Practically all failures in construction contracting may be attributed to one or more of five major sources: 1—Faulty bids, due to carelessness, misjudgment, or lack of

knowledge. 2—Insufficient finances, due to failure to analyze the quick assets needed for pay rolls, materials and retained percentages, or to a wish to appear important, or placing all their finances on one project. 3—Improper management—too many high salaries, too little attention to the job, failure to modernize equipment or buying too much equipment. 4—Inexperienced job personnel — underpaid superintendents, foremen, engineers and cost keepers. 5—Unforeseen conditions. But most of them are not unforeseeable; subsurface conditions can be ascertained beforehand; as can normal weather, stream flow, etc. Insurance should be carried against fire and accidents, but most of these can be prevented by proper precautions. Finally, "Learn from the mistakes of others; you can not possibly live long enough to make them all yourself."[N29]

Jacksonville's Oystershell Pavements

Jacksonville, Fla., has constructed oystershell pavements, on streets where traffic is primarily passenger cars only, since 1938, having laid 100,000 sq. yd. in 1947. The advantages are low cost, rapid construction, that work can be resumed almost immediately after rains, bleeding of the asphalt seldom occurs, and construction can proceed under a wide range of air temperatures.

A subgrade of high stability is necessary. On the sand subgrade, 2" of oyster shell dust (100% passing a No. 80 sieve) is laid and mixed with the top 6" of sand, using rotary tillers. The subgrade is then shaped with patrol graders and covered with clean oyster shells to a depth of 6" loose, which is compacted to 3½" with 10-ton smooth-wheel rollers, being heavily sprinkled during rolling. While this base is wet, 0.20 to 0.25 gal. per sq. yd. of emulsified asphalt is applied, followed by 40 lb. per sq. yd. of slag, which is rolled, 0.60 to 0.75 gal. of emulsified asphalt applied, and covered with 3 to 5 lb. of sand.[E8]

Composite I-Beam Highway Bridges

An ordinary I-beam bridge consists essentially of a reinforced concrete floor slab supported on a number of parallel steel I-beam stringers extending in the direction of traffic. In a composite I-beam bridge, some type of shear connection is provided to transmit horizontal shear between the slab and the beams, thus forming a composite steel and concrete T beam with the floor slab acting as the top flange. Both strength and stiffness of such composite beam are appreciably greater than the corresponding properties of the steel beam acting alone. Therefore lighter beams can be used, the saving in weight made possible varying from 8% for ordinary rolled beams to 30% or more for built-up welded beams.

In designing, a composite beam consisting of a slab and beam tied together by a suitable shear connector may be analyzed and designed on the basis of the transformed section. In I-beam bridges of ordinary proportions, a section of the slab having a width equal to the beam spacing may be considered effective as part of the composite beam.

Variations in the value of n, the ratio of modulus of elasticity of steel to that of concrete, have only a negligible effect on the properties of a composite beam. Except where it is desired to allow for effects of plastic flow, it is sufficiently accurate to assume a value of $n = 10$.

An investigation of channel shear connectors led to the conclusions that their effectiveness is approximately proportional to the width of the connector, and is increased by an increase in compressive strength of the concrete, but by a proportionally smaller amount for the higher compressive strengths. Variations in web thickness produced corresponding variations in the effectiveness of the connectors, but the magnitudes of these changes were far less than would be expected from the changes in section modulus of the channel web.

The paper describes in detail the analytical and experimental studies on which these conclusions were based. It was accompanied by two other papers,

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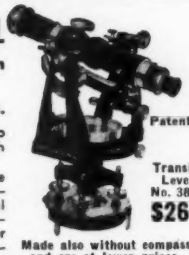

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one describing Laboratory Research on Concrete Bridge Floors, the other discussing the Design of I-Beam Bridges.[K1]

Mud Jacking With Emulsified Asphalt

Arkansas has been using mud jacking for several years in maintaining its old concrete pavements, using a soil-cement slurry consisting of 1 cu. yd. of sandy loam, 3 bags of portland cement, and sufficient water to give the desired consistency. But the effect of this was only temporary, as the seal was soon broken. After a year of experimenting they have adopted the following combination: 1 cu. yd. of sandy loam, 1 bag of cement (2 in winter), 65 gal. of emulsified asphalt, and sufficient water to give the proper consistency. The asphalt tends to lubricate the slurry mixture, prolonging the life of the pumps and reducing friction in the hose. Also it holds the sand particles in suspension. Tests of numerous bars show a shrinkage factor of less than 1%.[N32]

Highway Costs In Ontario Province

The fisca year which ended on March 31, 1948, witnessed the largest highway program ever undertaken by the Ontario Department of Highways and its partner municipalities. It is estimated that $75,000,000 has been devoted to the improvement of rural highways in the province. Partly this sum is based on post-war inflated values, but for most of the work the costs were comparable to prewar costs. The major projects were for grading, and bids received for this type of work were in the range of prices prevailing in 1939, increased costs for wages, material and machinery being offset by increased production from machines developed during the war. The same applies to the cost of bituminous pavements. Before the war a hot-mix plant required at least three weeks to install on expensive foundations, and if all went well, it could turn out 800 tons of mixed stone or gravel per day. Now a contractor can have a modern, continuous-flow mixer in operation in two days with an output exceeding 1,200 tons.[O16]

Care of Road Machinery

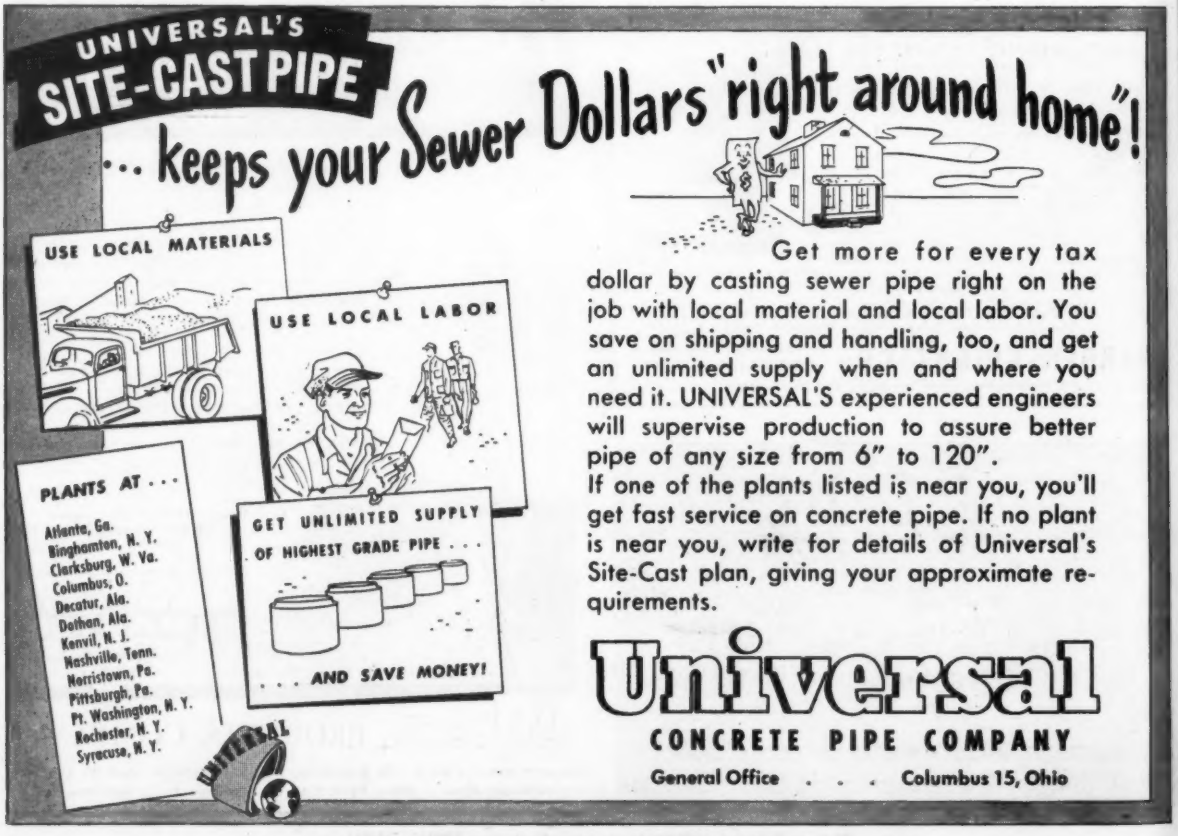
The importance of proper housing for power equipment cannot be overemphasized, as it has been proven that low temperatures have a definite influence on the life and strength of vital working parts. Metals break 10 to 50% quicker in sub-zero than in normal temperatures; therefore equipment housed in reasonably warm buildings may be expected to cost less for maintenance and have a longer life-expectancy.

Lubrication should be regularly and systematically attended to, and manufacturers' specifications should be followed so far as possible, particularly with regard to the viscosity of oils and lubricants used under different temperatures.

Equipment in daily operation should be given a regular weekly preventive maintenance inspection. This should cover the ignition system, battery, oil filters, air cleaners, clutch, brakes, axle nuts, wheel studs, steering gear, universal joints, shackles, hydraulic controls, tires, etc. [O17]

Profits in Road Construction

Overhead costs on a construction job remain relatively constant regardless of the dirt-moving units used; and the cost per hour for owning and operating various similar units which differ only in size is sufficiently small so that the deciding factor as to the best machine is the production rate in yards per hour. If a tractor-scraper making ten trips per hour can reduce its trip time by one minute, the number of trips is increased by two per hour—which may make the difference between profit and loss on the job. Time studies on actual jobs show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that the following items are among the primary "money losing" factors:

1. Waiting for fueling and lubrication.
2. Waiting to load.
3. The wrong equipment for the job.
4. Abusive or improper use by operator, resulting in excessive repairs.
5. Lack of routine policy for servicing and making minor adjustments. (Should be done at a time when machine is normally idle.)
6. Poor haul road.[L10]

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1. Photographic Surveying in Relation to Road Engineering in Highly Developed Countries. By B. F. J. Bradbeer and C. A. Hart. Pp. 19-21.

March 24

2. The Economic Use of Plant on Motorway Construction. By E. A. Palmer. Pp. 28-37.

March 31

3. The Economic Use of Plant on Motorway Construction. By E. A. Palmer. Pp. 13-16, 26.

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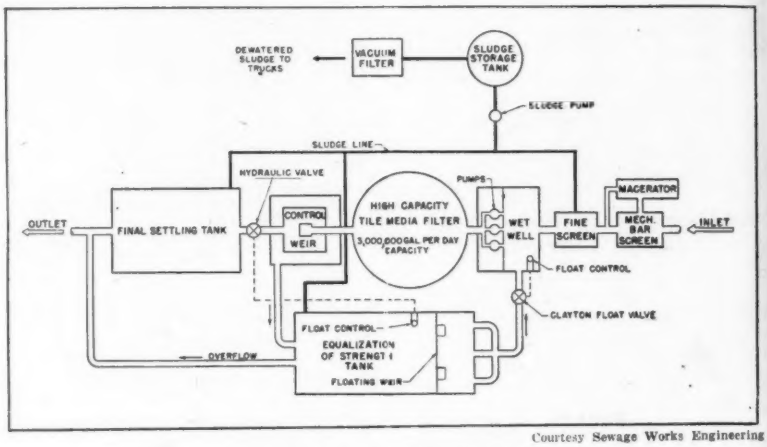
The Sewerage Digest

Treating Pea and Milk Wastes

The plant described, now under construction at Ladysmith, Wis., is intended to treat domestic sewage from a population of 4,000 plus industrial wastes equivalent to 24,000 population; the principal wastes being from pea and bean canning and milk processing. The treatment decided upon was the biological, with departures from standard design. Filtration is preceded by a coarse screen, macerator, and self-cleaning fine screen with 10 meshes to the inch. The medium in the filter consists of tiles with 1" round holes extending vertically from top to bottom, which medium is expected to eliminate the hazard of casein deposits and the ponding common with rock media. The design loading for operating as a high capacity filter is 3.3 lb. per cu. yd., "permitting the use of a unit less than 10% of the size of a low-capacity filter, which can be housed economically and thus provide odor control, fly control, and better treatment in cold weather."

The filter is followed by two settling tanks, one called an "equalization-of-strength tank" which "acts as a variation of the metering or holding tank principle." The sludge will be dewatered on a vacuum filter.[H19]



Courtesy Sewage Works Engineering

Ladysmith waste treatment plant.

Suggestions for Sanitary Dumping

In selecting a site for a sanitary dump ("controlled tipping" is the English author's term), consider accessibility, capacity, locality to be served with reference to length of haul, presence of a water course (requiring a culvert), number and nature of access roads, proximity of dwellings, availability and nature of covering material. A dump less than two layers (14 ft.) high would be uneconomical. The removal of sod and top soil for use on the final top level should be considered. If there are nearby residences, tip in a direction away from them so that the face of the dump will not be in view. Planting trees along the boundary of the site improves the appearance. Dump in layers about 7 ft. deep and 45 ft. wide, the latter providing ample space for maneuvering vehicles. Flies and other insects can be kept under control by constant agitation of the dump surface by raking and brushing.[D19]

Scum Control in Digestion Tanks

When the rate of gas production in a tank is speeded up by the application of a high dose and heat, gas becomes enmeshed in the sludge and it floats to the surface. If the gas is released by agitating the sludge, it will settle but will float again in a few hours or days, but after a few trips up and down, will stay down until it receives another dose of fresh solids. In a heated digester at Washington, D.C., without facilities for degassing floating sludge, the greater part of the digestion takes place in the floating material. Unless broken up, the scum compacts itself to a sludge of 15 to 20% solids, which is too thick to flow and plugs up the outlet. This plant is receiving nearly twice the sludge it was designed for—1.5 lb. of volatile matter per cu. ft. capacity a month.

One of those who discussed this paper claimed that scum could be controlled by installing mixers capable of turning over an entire tank contents in 30 to 120 minutes, for which internal agitators are more economical than external pumps. Another stated that "mechanical agitation is *not* the panacea for scum troubles" but recommended keeping the top sludge moist, at optimum temperature and sufficiently agitated to minimize entrained gas, recirculating heated liquor from the intermediate zone into the scum zone, possibly adding ammonia nitrogen in extreme cases.[X16]

Designing Sewage Works

"The best way in which the designer (of a sewage works) can achieve high-class results is to study the requirements of the operator." The requirements can be grouped as: factors which facilitate plant operation, economize labor, improve working conditions, and others too often overlooked. Among those that facilitate operation are mentioned ease of control, uniformity of performance, flexibility, compactness, accessibility and simplicity. Under ease of control, one of the items named was providing each unit of the plant with sampling points at inlet and outlet, accessible in storms and at night. It is advantageous to so group the plant units that all can be seen from the manager's office; that good foot paths lead to the screens, flow recorders, valves, sampling points and others that need to be inspected regularly; and that the distances to be walked are short. Accessibility for maintenance and repair are important in selecting the method of heating digestion tanks and the aerating devices for activated sludge tanks. Adequate facilities for dewatering sludge are of the greatest importance.[D20]

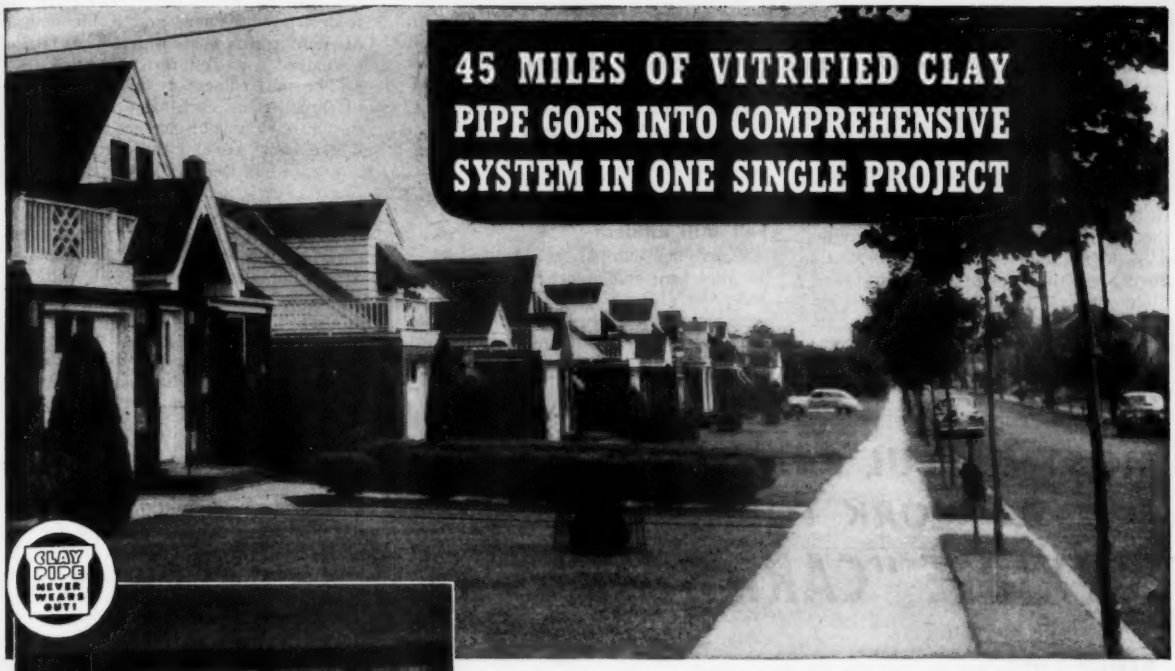
An Oc Test For Sewage

This paper presents a rapid analytical procedure for determining chemically the amount of oxidizable material present in sewage. A small aliquot of sewage is added directly to a small volume of a 1-1 mixture of phosphoric and sulfuric acids plus some potassium dichromate and the mixture refluxed for sixty minutes in the presence of selenium. The amount of dichromate remaining after oxidizing the sewage is determined chemically and the oxygen consumed value is calculated by the difference in the dichromate present originally and finally, and is corrected for the chloride concentration of the sample.[G15]

Treatment at Federal Institutions

The Federal Bureau of Prisons operates 27 institutions varying in size from work camps with 200 or 300 inmates to penitentiaries with 2,500 inmates. Of these, 18 have sewage treatment plants. Several of the small ones are septic tanks only, but ten provide complete treatment. Since labor is plentiful but skilled operators are rare, the use of mechanical equipment is avoided so far as possible.

At these institutions, water use averages 150 to 350 gd per inmate, 600 gal. at one institution, 60% to 80% of which



Engineers on the Fair Lawn, New Jersey sewerage installation were Bowe, Albertson and Associates of New York City.

45 Miles of Vitrified Clay Pipe and Clay Pipe fittings, ranging in diameter from 4 inches to 24 inches, were included in the specifications for the sewerage system of the Borough of Fair Lawn, New Jersey. The entire community was sewered as a single project done in two contract stages.

Borough officials and the consulting engineer on this two-million dollar project specified Vitrified Clay Pipe because they wanted a long-lasting, permanent installation. For they, like hundreds of other officials and engineers, know that Vitrified Clay Pipe is the only pipe impervious to the action of corrosive materials, acids and alkalies. In fact, there is no instance on record where Clay Pipe has ever worn out in any municipal sewerage or drainage installations.

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reaches the sewage plant. The maximum 1-hr. flow may be 3 times the average and fall to only 10% or 20% for several hours after midnight. The character of the sewage appears to approximate closely to that of army camps. It is thought that 30 or 40% of the day's BOD may reach the plant in 1 hour. Some of the suggestions for designing such plants are: Select the process to fit the conditions. Provide for receiving 35% of the flow and 60% of the BOD during a 4-hr. period; trickling and sand filters, which withstand and rebound after shock loads are superior to the activated sludge process. Make operational procedures as simple as possible and keep mechanical equipment at a minimum while avoiding laborious or obnoxious operations. Because inmates throw rags and clothing into the toilets, mechanically cleaned screens seem desirable. In view of operational problems, the use of sand filters may be more effective than chlorination in destroying pathogenic bacteria.[X12]

Purifying Felt Mill Effluent

Congoleum-Nairn, Inc., manufactures an absorbent felt paper at Cedarhurst, Md., the waste water from which contains fiber, fiber debris and soluble mineral and organic matters present in the rags and wood pulp used. The company conducted experiments in a pilot plant to determine the most practicable method of treating this waste water. That finally developed is as follows:

The mill effluent is delivered to one of three basins, each of which will hold the entire volume discharged in one week. These basins are on a three week cycle of (1) Fill, (2) Rest, (3) Discharge to the filters. The lagoon effluent at an average B.O.D. of about 2000 is pumped to a mixing box ahead of the primary filter and diluted with five times its volume of final filter effluent to give an entering B.O.D. of about 375. This volume is delivered to the primary filter, 170 ft. in diameter (½ acre) and with 8 ft. of stone. The primary filter discharges by gravity to a settling basin which in turn passes the water on to the secondary filter, again 170 ft. in diameter, and a secondary settling basin.

The outflow from the secondary sludge remover is split with 5/6 of the total returned as diluting water to the primary filter mixing box and the remainder of the water goes through a chlorinator to storage for reuse in the plant or discharge to the stream. The sludge from the two settling basins is pumped, if necessary, or flow by gravity, first to a thickener and then to the sludge digester.[X14]

High-Rate to Replace Sand Filters

Since 1891 the sewage of Marlborough, Mass., has been treated on intermittent sand filters, which finally covered 2 acres, with an additional ¾ acre of sludge beds. The sand has gradually become clogged and incapable of treating the sewage properly, even with the installation of settling and dosing tanks ahead of the filters. Following orders from the State Dept. of Health, a new plant was placed under construction in 1940. This consists of a grit chamber, 2 Comminutors, 2 Imhoff tanks, 2 high-rate trickling filters, secondary settling tank, and recirculating and sludge pumps.

Either secondary tank effluent or a mixture of this and secondary tank sludge can be recirculated, either through the Imhoff tanks or directly through the filters. Probably recirculation will be through the Imhoff tanks when the flow is low, to prevent long detention there and resultant septic conditions. The high-rate filter effluent will be discharged during the summer upon 16 of the old sand filters.[H21]

Septic Tanks for Sludge Digestion

Years ago septic tanks were made too small, buried under earth, and rarely cleaned. With improved design and operation these faults can be corrected and permit an economical design for limited connected population. The idea that septic tank effluents are so stale or septic as to seriously impair the efficiency of secondary processes such as sand filtration or contact beds is not correct; their over-all removal of solids and BOD is equal and usually superior to all other types of sewage

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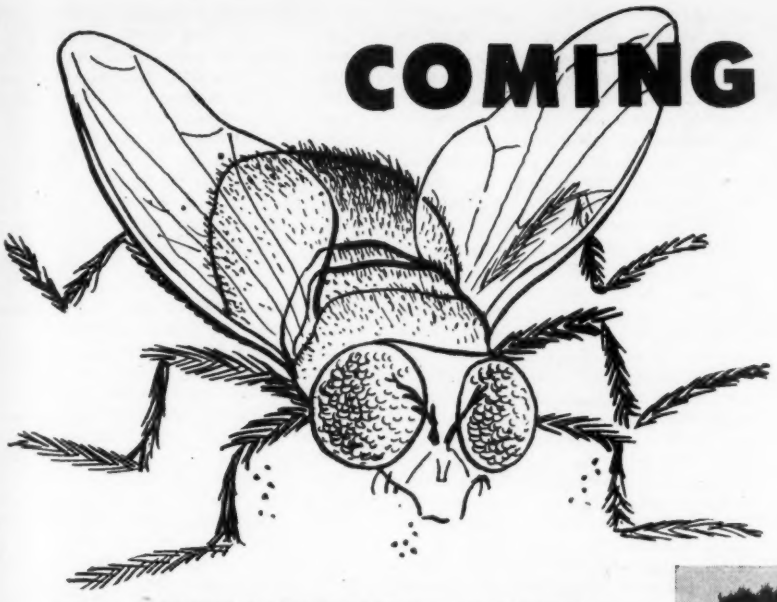

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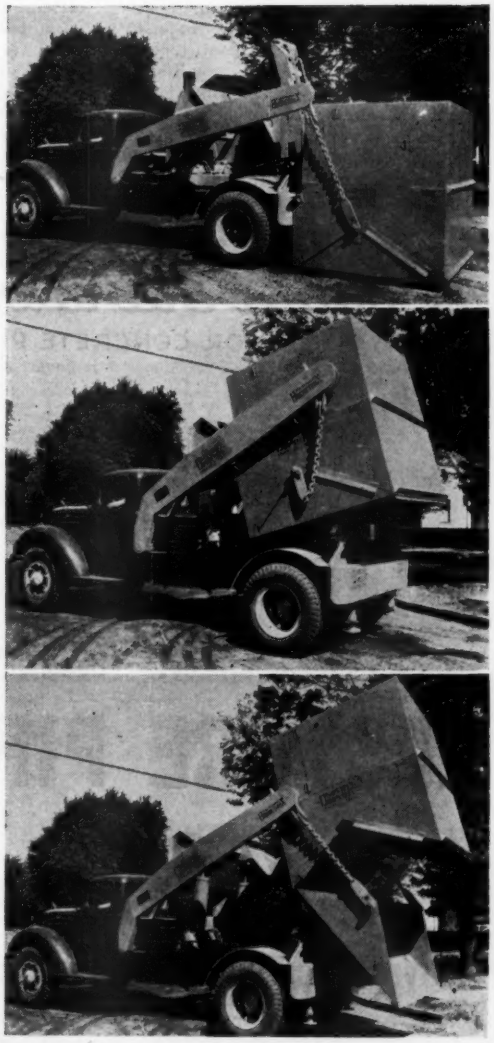

SHOWN AT RIGHT: *Hoisting unit with 10 cu. yd. body, preparatory to pick-up operation. Center: Body in carrying position. Bottom: Body in dumping position. Note how drop-bottom forms chute to guide trash.*

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treatment. The septic tank has a special field of usefulness for small villages, institutions and factories.

Design requirements are: 2 to 4 tanks in parallel; bottom sludge draw-offs (*not* riser types) or pumps; scum draw-offs; top of tank fully accessible; size sufficient to provide 6 to 8 hr. detention for average daily flows plus at least 3.5 cu. ft. per capita for storage of sludge and scum; bottom sloping at least 1:1 to a sump; minimum depth of 6 ft. for large tanks and 3 ft. for small; if sludge must be pumped, provide coarse bar screen and grit chamber; good inlet distribution and outlet baffles; water under pressure for cleaning tanks.[G14]

Design Standards

A canvass of all the State Boards of Health appears to show that only 17 publish rules setting forth full suggestions on the capacities, volumes and other units which must be provided in sewer and sewage treatment plant designs in their States, and the majority of these are willing to modify their standards to meet local conditions. Georgia operates on the principle of "having a meeting of the minds between the designing engineers and us on every sewage treatment plant before final design is started. . . This stimulates advancement in the methods of sewage treatment but controls the design to assure a plant adequate and satisfactory to the particular problem being solved." Massachusetts "relies upon the fact that the consulting engineer should be familiar with modern sewage design, and prefers that he prepare his plans in accordance with his own theory. An engineer of this Division studies the plans and the official communication is then sent either approving the plans as submitted or recommending such changes as are considered advisable."

Nebraska's Director of Sanitation has destroyed all "so-called standards of design" that he could locate, because they were being used as a basis of design. "Since destroying these, I find that more liberal design is used throughout the State and that the engineers are actually making a study rather than using their Rules and Regulations as a text book." Oklahoma finds that "in many instances the engineers are inclined to use these standards rather than to make studies of each of the individual problems and then prepare their plans accordingly." They have set up certain standards for checking plans submitted to them but have not released them for distribution. The above are typical of comments made by a majority of the State boards of health.[H22]

The design factors covered by this survey include Sewers, Grit chambers, Settling tanks, Sludge digestion, Sludge dewatering, Trickling filter, Chlorination, Activated sludge, and Chemical precipitation. For each of these, the essential details are published in tabulated form. For example, the factors for Plain Settling Tanks were: Minimum detention period, Surface loading daily, and Overflow rate daily; and for Imhoff tanks, Minimum detention period and Sludge Capacity per capita. The minimum detention period specified was 2 hrs. (in three states); 2 hrs., or 1.5 hrs. ahead of activated sludge; 2 hrs., or 1 hr., for activated sludge; 2 hrs. based on 16 hr. flow; 2 to 2.5 hrs.; 2 to 3 hrs. (in two States); 2 to 4 hrs.; 2.5 hrs.; 2.5, with 1.5 ahead of activated sludge in two states; 4 hrs. in one state. All the details are tabulated for each of the design features.

Some interesting ideas are embodied in the requirements. For example, Iowa requires, for Imhoff tanks, 3.5 cu. ft. digester capacity in the northern section of the state but only 3 cu. ft. in the southern section. Iowa also is unique in requiring only 1.5 cu. ft. per capita for heated digestion tanks treating filter sludge, and in not approving unheated ones. In connection with trickling filters, the rates of sewage application specified vary from 2 mgad for a 6.25 ft. bed in Texas to 4 mgad in Florida; or from 200,000 gal. per acre-foot per day in So. Dakota to 630,000 in New Jersey.[H18]

Synthetic Detergents And Sewage Treatment

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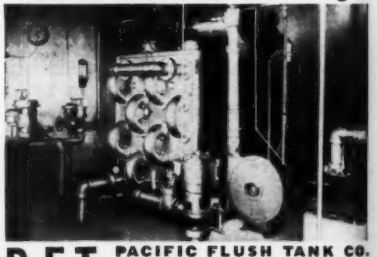

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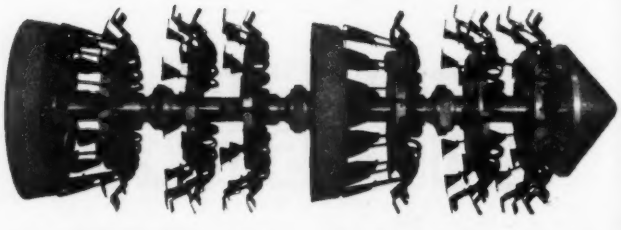

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synthetic detergent, or grease emulsifier, has recently been evolved. This product is in great contrast to soap, or soda-neutralized sulphated or sulphonated products which belong to what is known as the anion class of emulsifiers or detergents, because their dissociation in water produces effective anion groups operating as the detergent agent. No definite dissociation is obtained in solution in water of this newest type of detergent, and since positive and negative ions are not formed, no effect is obtained by the addition of acids, alkalies or metallic radicles. It is probable that the use of this class of material will increase considerably in the future.

These detergents are not naturally precipitated in sedimentation tanks but pass unchanged to the oxidation stage, where the presence of additional colloidal solids plus the extra oxygen demand may present difficulties. There does not seem to be any way to prevent householders from discharging these detergents into sewers, but their presence in industrial wastes may be classed with that of other matters prohibited by law. If the detergents can not be excluded from sewage, some more costly precipitation process may have to be used, with probable increase in volume of very bulky sludge.

Extra biological plant may well be required, and this also applies to the works even where mainly domestic sewage is treated. Work has still to be done on the dispersed solids carried over to filtration and activated sludge treatment, and it is known that extra difficulty will be experienced in the disposal of the secondary sludge that is almost certain to be formed. It is therefore quite conceivable that if no satisfactory result is achieved the cost of sewage treatment will be increased very materially.[D12]

Garchey System of Refuse Disposal

This is a system of removing household refuse by water carriage, first tried in Paris in 1927. In 1938 it was installed for a large apartment building at Leeds, England, on the recommendation of R. A. H. Livett, the city architect; who does not consider it suitable, however, for any but dense populations in central areas. In general, it consists of a deep kitchen sink, into which is placed all garbage, ashes and other household refuse, and the waste water. The sink 2" outlet is closed, but is opened when necessary and the contents discharged through a strainer into a container, which in turn discharges through a 6" pipe to an outdoor collecting chamber, which is connected to an 8" suction pipe system leading to a central station. Here "the liquids and solids are violently drawn by suction into receiving tanks, and by means of compressed air the refuse stored in the receiving tanks is then lifted up to the hydro extractors, where by centrifugal force all the liquid matter is separated and conveyed to the sewer" and the solid residue is dried and burned. What becomes of the tin cans, bottles, bones and other large solids (which presumably remain in the sink or the container under it) is not explained. The cost in 1938 at Leeds for 1,000 dwellings (apartments?) was 25£ 8s. per dwelling, and the operating costs were 1£ 7s. per dwelling.[18]

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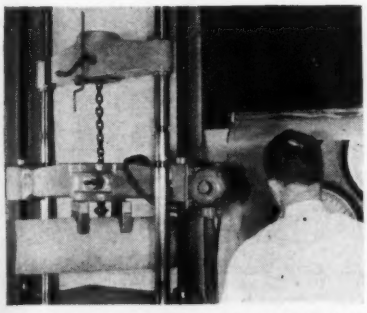
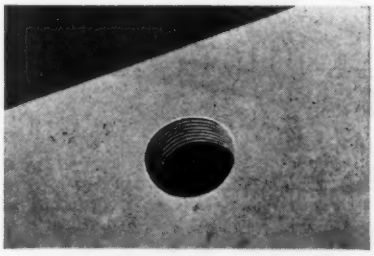
One of the many practical features of Transite* Pressure Pipe is the ease with which it may be tapped for service connections. Proof of this is evident in the hundreds of thousands of corporation stops which, over the years, have been inserted in Transite water mains. Year after year, these installations continue to serve their communities with efficiency and economy.



Laboratory tests demonstrate the strength of service connections made in Transite Pressure Pipe. In a recent series of such tests made on 8" Class 150 pipe, it required an average force of 4360 pounds to pull a ¾" corporation stop from the pipe.

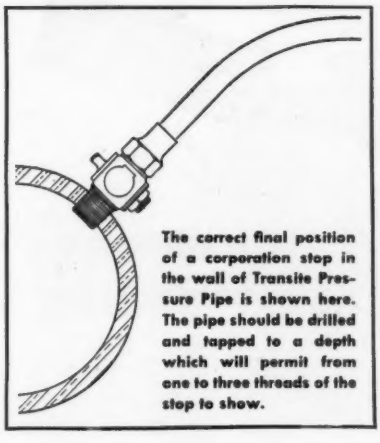
Transite Pipe can be tapped wet or dry; standard tapping machines are used. The special asbestos-cement composition which gives Transite its toughness and durability also provides excellent threading properties. The threads are sharp, clean and strong. Service connections are tight and lasting.

To facilitate tapping and insertion of the corporation stop, the use of a lubricant such as graphite and oil on the tap and the threads of the stop is recommended.



As this photograph shows, Transite Pipe takes clean, sharp threads. Strong and firm, these provide perfect seating for the threads of the corporation stop, assuring a watertight service connection.

Taps may be made with either Corporation Stop threads or Iron Pipe threads. While the standard combined drills and taps may be used, special alloy ones have been developed and are available from leading manufacturers. Field experience shows that these special drills and taps remain sharp after prolonged use and are more economical than standard tools.



The correct final position of a corporation stop in the wall of Transite Pressure Pipe is shown here. The pipe should be drilled and tapped to a depth which will permit from one to three threads of the stop to show.

As is true with any tapped connection, maximum strength is obtained by engaging the greatest possible number of threads of the corporation stop in the pipe wall. With Transite Pipe, this means that after the pipe wall has been properly drilled and tapped and the corporation stop fully inserted, from one to three threads of the stop will show.

Transite Pressure Pipe is readily tapped with standard tapping equipment. Here the combination drill and tap is about to be inserted in the tapping machine.

Additional engineering data relating to service connections will appear in a future advertisement in this series. For further information, address Johns-Manville, Box 290, New York 16, N. Y.

*Reg. U. S. Pat. Off.

JOHNS-MANVILLE JM PRODUCTS

31. Chlorination of Sewage. By N. S. Chamberlin. Pp. 304-318.
32. Paints and Protective Coatings. By Walter A. Sperry. Pp. 319-323.

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12. Preparation of Sewerage and Sewage Disposal Schemes for Rural Areas. By A. Rock. Pp. 111-112.
13. Sewerage and Sewage Disposal in 1947. Pp. 115-117.

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14. Effect of Synthetic Detergents on Purification. P. 123.
15. Sewerage and Sewage Disposal in 1947. Pp. 127-128.
16. Inspection and Control of Trade Waste Effluent Discharges. By M. A. Kershaw. P. 130.

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17. Birmingham Tame and Rea District Drainage Board's Proposed New Works. By F. C. Vokes. P. 137.
18. Sewerage and Sewage Disposal in 1947. Pp. 141-143.

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19. The Practice of Controlled Tipping as a Means of Refuse Disposal. By J. W. Call. Pp. 149-150.
20. Sewage Works Design and Operation. By H. H. Stanbridge. Pp. 151-153.

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21. Waste Waters Discharged From an Abattoir. By E. E. Jones. Pp. 159-160.

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22. Refuse Disposal by Controlled Tipping. Discussion of D 19. Pp. 175-176.

E *Engineering News-Record*

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15. Diversion Factors for Combined Sewers. Comments by Thos. R. Camp, Charles P. Reming, Gordon M. Fair, Henry W. Taylor, John C. Stevens, M. Le Bosquet, Jr., L. L. Sphar, G. T. Sparrow, Chas. S. Spencer, and Richard Hazen. Pp. 90-93.

G *Water and Sewage Works*

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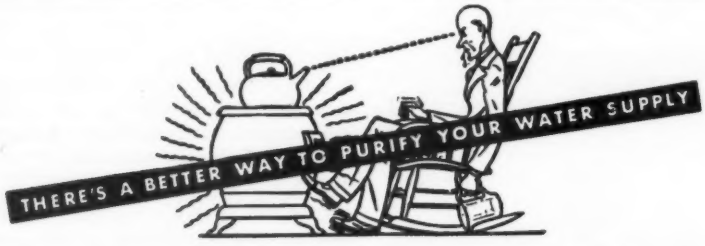
14. Digestion of Sewage Solids. By Leroy W. Van Kleeck. Pp. 104-106.



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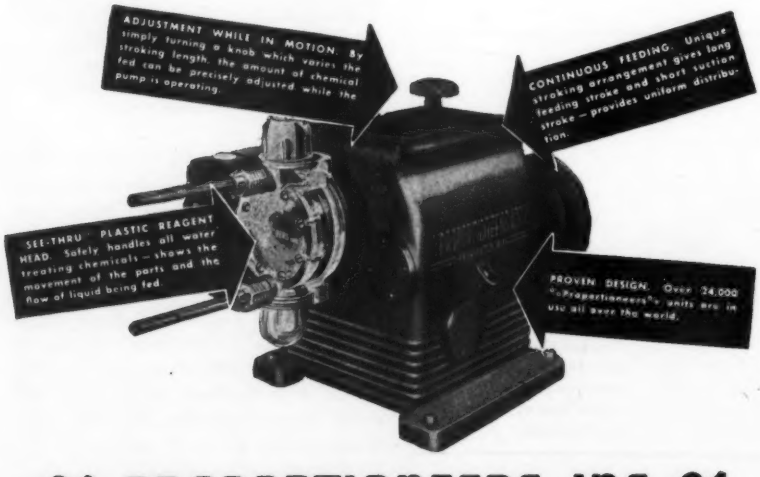
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15. An Oxygen Consumed Test for Sewage. By R. S. Ingols and P. E. Murray. Pp. 113-117.

H *Sewage Works Engineering*

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18. National Survey of Sewage Works Design Requirements. Pp. 117-123.
19. Designing Screen-Filter Plant for Pea and Milk Wastes. By A. W. Banister and R. J. Ellison. Pp. 124-125.
20. Designing the Sewage Works for Mission Township, Kans. By F. M. Veatch. Pp. 126-127, 169.
21. From Intermittent Sand to High Capacity Filters. By E. Sherman Chase. Pp. 128, 169.
22. The Why and Wherefore of Sewage Works Design Factors. A Symposium of State Sanitary Engineers' Opinions. Pp. 129-135.
23. Basic Design Factors for Sedimentation and Filtration. By C. A. Smith. Pp. 136-137, 173.
24. Novel Construction Methods Save Costs in Small Plants. By B. V. Howe. P. 139.
25. Fertilizer Production Increased at Battle Creek Sewage Plant. P. 140.
26. Procedure in Controlling Bulking of Activated Sludge. P. 141.

I *Municipal Engineering (England)*

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8. The Garchey System of Refuse Disposal. By R. A. H. Livett. Pp. 130-132.

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9. Two Years Work of Manchester Rivers Department. Pp. 144-146.
10. Dewatering Sewage by Coagulation and Vacuum Filtration. By J. M. Wishart, C. Jepson and L. Klein. Pp. 148-150.

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11. The Practice of Controlled Tipping as a Means of Refuse Disposal. By J. W. Call. Pp. 156-158.

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12. New Problems in Sewage Treatment, With Special Reference to Synthetic Detergents. A Symposium. Pp. 175-177, 182.

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11. Asheboro Surfaces Secondary Streets. By Clifford Pace. Pp. 113-114.
12. An Activated Sludge Improvement. By Martin A. Milling. Pp. 118-119.
13. Sewerage Survey Develops a 40-Year Regional Plan. By Vinton W. Bacon and Charles H. Diggs. Pp. 124-126.

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T *South African Municipal Magazine*

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2. Some Notes on Refuse Collection. Pp. 33, 35.

X *Proceedings, Maryland-Delaware Water and Sewerage Ass'n*

Year of 1947

12. Institutional Sewage Treatment. By Graham Walton. Pp. 27-32.
13. Sanitary Land Fill at Baltimore, Md. By Geo. H. Elliott, Jr. Pp. 33-41.
14. Purification of Felt Mill Effluent. By W. Y. Irwin and A. H. French. Pp. 47-57.
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16. Sludge Digestion and Operation Troubles. By Paul D. McNamee and J. E. Rice. Pp. 70-80.

Y *Contractors Record (England)*

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4. Sewage Works Design and Operation. By H. H. Stanbridge. Pp. 11-16.

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5. Do Combined Sewerage Systems Result in River Pollution? By N. C. Cregeen. Pp. 11-12, 26.

When you need special information—consult the **ENGINEERS' LIBRARY** *on pages 77-80*

Views of Milwaukee's street widening work program.

Street Widening Problems in Milwaukee

JOHN E. HUBEL

DUE to a change in transportation operation in Milwaukee—the substitution of buses for street cars and subsequent street widening work along several miles of streets have been inconvenienced by the construction necessitated by paving and relaying water pipes. Also, as 3 ft. of sidewalk on each side of the street are cut off for the widening, sidewalk vaults must be filled in or new retaining walls built after the old wall is cut down 3 ft. so as not to interfere with the street level after the widening. These vaults or hollow sidewalks were put in from 40 to 75 years ago to provide covered storage spaces for coal and merchandise. However, with the coming of oil burners and discontinuance of coal storage, many of these storage spaces under the sidewalks are no longer of considerable value.

The frontage owner pays for having the hollow space under the walk filled in with sand or, if the storage space is still useful, the retaining wall against the street is cut down by three feet and a new wall built, all at the expense of the property owner.

Since this street widening project, the most ambitious undertaken in Milwaukee, requiring repaving of the street, it was considered advantageous to install new water piping to avoid tearing up the street again in the near future, as the existing piping has been in use for 50 years or more. New trenches, one on either side of the street, are dug close to the curb at the old street width, which will bring them 3 ft. away from the new curb after widening. This double line of water pipes, which is a desirable practice on busy streets, avoids running service pipes across the street, as would be required if there were only one pipe in a street.

In digging the trenches for the water pipes on this busy street, all of the earth removed from the trenches which are 6 to 8 ft. deep, is hauled away immediately as it is dug up, and, when the pipes have been laid, sand is substituted for the earth removed. Sand was selected as it packs well around the pipes, and, when the top of the trench is filled, the sand makes a better temporary surface than wet earth. As the street cannot be surfaced in the winter, the sand top is left on the trenches until a temporary asphalt surface is laid over them.

New water hydrants are immediately installed along the route of the new piping, jutting into the old sidewalk 3 feet from the old curb. Later the big job of moving the heavy ornamental concrete light poles, and the trolley poles will have to be done, but this may be left until later.

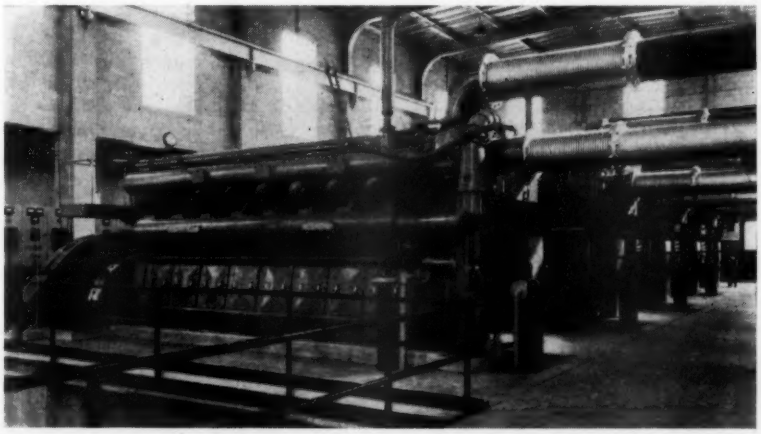
Soil-Cement Construction Record

As equipment manufacturers develop better construction equipment and engineers and contractors gain more experience in soil-cement construction, new records in production are established.

On August 26, 1947, Nello L. Teer Co., contractor from Durham, N. C., completed 5,700 ft. of 16-ft. soil-cement base, 6-in. thick in 10 hours, a postwar daily footage record. This record was established on Route 635, Mecklenburg and Lunenburg Counties, Va., using a traveling mixing plant which mixes soil, cement and water in one pass.

This 1.08 miles of soil-cement base is equivalent to about 2,700 to 3,000 tons of paving material mixed, compacted and finished during this record time.

Well-organized construction crews, proper equipment in first-class working condition, and synchronization of construction procedures produce such construction records. —*Soil-Cement News*



Interior of the new supercharged diesel power plant, 5,000-kw capacity, recently put into service at New Bern, N. C. The illustration shows the 1440-hp Superior engines and the 1000-kw generators.

The Waterworks Digest

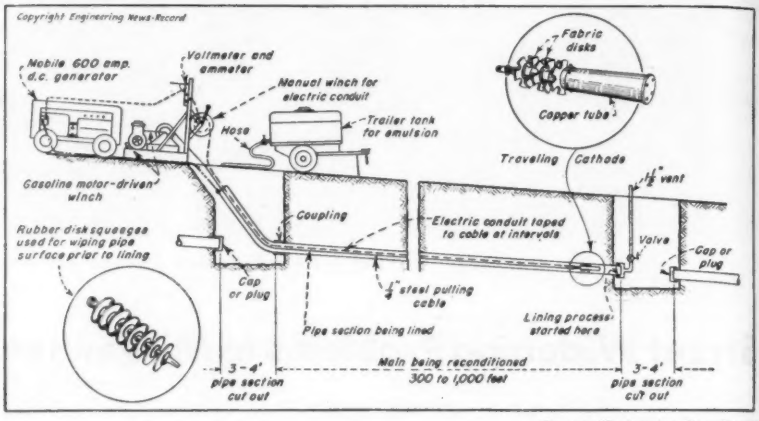
Overloading Rapid Sand Filters

The rapid sand filters of the Groton, Conn., treatment plant were designed for 125 mgad (2 gm per sq. ft.) and were operated at this rate for three years. But in 1943-46 war conditions necessitated operating them with an average of 36% overload, with a maximum month of 49%. During these four years the length of filter run naturally decreased, but the quantity passed per cycle remained undiminished, indicating that there was no filter deterioration. Percentage of wash water remained within limits of 2.5% to 4.5%, giving no indication of distress. Routine hand raking of the beds during washing has been an important factor in preventing the formation of compacted areas.

This experience indicates that, with careful, intelligent operation, it is possible to operate filters for long periods at rates approaching 3 gpm per sq. ft., if preceded by adequate preliminary treatment. But the author would design to 2 gpm only, reserving the ability to overload as a factor of safety. [B11]

Rehabilitating Small Water Mains

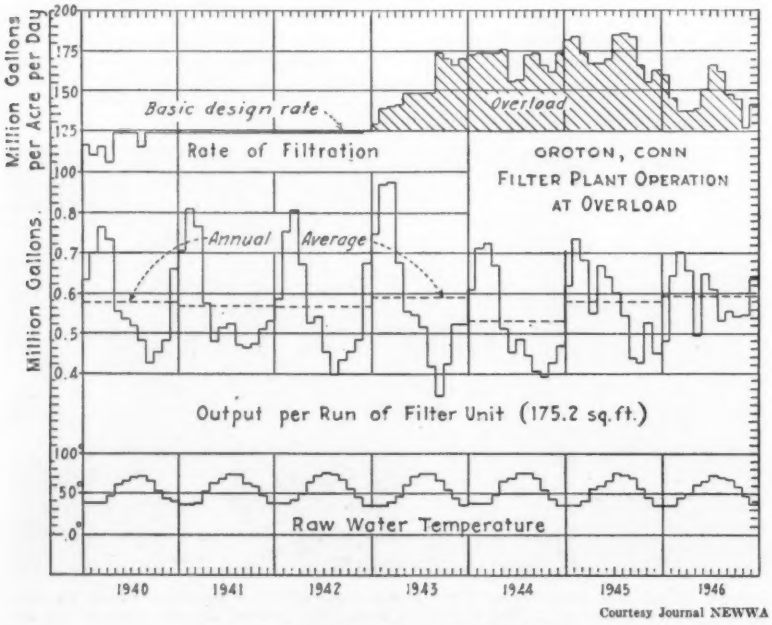
The Pittsburgh- Eric process is an electrolytic method for depositing a bitumen compound in aqueous solution on the pipe interior; a process similar to electroplating copper or silver. Cables from a generator are connected, one to the pipe, which acts as the anode, the other to a cathode which is drawn through the main. Molecules of bitumen are deposited on all metallic surfaces within the area influenced by the cathode until a thickness of bitumen is deposited sufficient to prevent the passage of current. Metal areas that are not completely clean will not hold a coating, consequently it is imperative that the entire inside of the pipe be clean. The coating is approximately the thickness of a good tar-dipped coating, adheres tenaciously and is tough and will not crack. The total cost for pipe 8" and smaller will generally be under a dollar. [B5]



Courtesy Engineering News-Record

Equipment used for reconditioning water mains at Highlands.

In applying this process recently to 11,000 ft. of 4" and 6" pipe at Highland, N. J., five steps were taken: 1—locating the pipes; 2—isolation of the 300-1,000 ft. length to be lined and removal of a short length of pipe at each end; 3—mechanical cleaning of this length; 4—squeegeeing it; 5—lining it with bitumen. For cleaning, a 3-section cleaning tool was drawn through by a ½" cable and a gasoline motor-driven winch, then drawn back, and this repeated 2 to 8 times. Then the material scraped off was flushed out, and all moisture removed from the pipe wall with a rubber squeegee. The cathode, a 2" copper tube connected to the negative pole of a 600 amp. generator by a rubber-insulated electric conduit, was then drawn through the pipe, which had been filled with a patented bitumen emulsion; the pipe having been grounded to the positive pole of the generator. After completing the coating, the emulsion was pumped out, and house connections and laterals were back-flushed. After adjacent sections of the main had been treated, the lengths which had been removed were replaced. [E9]



Courtesy Journal NEWWA

Filter plant operation with overload conditions.

Financing a New Water Supply

The Anderson, Ind., water supply has been becoming increasingly polluted and deficient in quantity, and to remedy both of these without increasing its indebtedness the city has contracted with the Anderson Killbuck Corp. to construct a Ranney well system to take water from under Killbuck Creek and sell the water to the city at rates ranging from 2.2 ct. per 1,000 gal. for the first 6.5 mgd. to 0.8 ct. for all in excess of 7.5 mgd., agreeing to buy a minimum of 6.5 mgd. (The

city's average water use is 7.4 mgd.) The city takes the water at the well, doing the necessary pumping. At the end of 15 years the city obtains title to all the property on payment of $1.00. The water will be ample in quantity, softer than the present river supply, and have a more nearly constant year-round temperature. [J4]

Increasing Well Discharge

Wauwatosa, Wis., obtains its supply from 6 wells, 1,600 to 1,900 ft. deep below the pump base. The yield of these has been decreasing due to lowered static level, incrustation of wells, insufficient depth of pump settings, and inadequate equipment. A committee of engineers recommended, as a remedy, lowering all pumps to 440 ft. below datum and reconditioning them; install a new well in a new location; acidize certain wells; restricting lawn sprinkling; recommending a state law declaring underground water a public utility to be regulated by the state; and determining rates adequate to provide funds for replacing equipment. In accordance with these recommendations, a 19" well 1,750 ft. deep has been drilled; wells have been acidized and their capacities thereby increased an average of 30%—some of them more than 60%; sprinkling lawns is restricted to two-day intervals, odd-numbered houses sprinkling lawns on odd-numbered days and even numbers on even days. The state has passed a law requiring a license for every well larger than 100,000 gpd. [J7]

Taste and Odor Removal

East Chicago, Ind., takes its supply from Lake Michigan, which is badly polluted by taste and odor-producing wastes of industries. Several methods have been tried to remove the tastes and odors, including free residual chlorination, chlorine dioxide and activated carbon. One great difficulty in using the first was that the ammonia or organic content of the raw water varies considerably, causing ever-changing chlorine demands. In 1946-47 chlorine dioxide was tried, but it appeared that oil refinery wastes consisting of hydrocarbons could not readily be oxidized to tasteless and odorless end products by this method. Activated carbon applied as a slurry to the top of a filter immediately produced a palatable water with a low threshold odor number, and they concluded that "activated carbon is the one taste and odor control method that we can rely on to assure delivery of a uniform completely palatable tap water." . . . The amount of activated carbon necessary to produce a palatable water will vary from time to time—being dependent upon the type of taste and odor present as well as the concentrations. Our plant operators determine the threshold odor number of the raw water and at the same time observe the type of odor present, and the activated carbon dosage can then be estimated very closely from knowledge of the amount of odor removed by its previous use. [X18]

Contamination by Radioactive Substances

Contamination of water by radioactive materials under normal peacetime conditions can occur in two ways: 1- through induced activation, by means of neutron absorption of cooling water which is run through piles used in the production of atomic energy or radioisotopes, or 2- through the disposal of waste radioactive materials into water. Under wartime conditions the water may be contaminated as the result of atomic bomb bursts, or radioactive materials may be introduced deliberately into water supplies as a form of sabotage.

The hydrogen and oxygen of water are both very poor neutron absorbers and form only very short-lived radioisotopes when absorbtion occurs. However, dissolved or suspended materials in water may have a high capacity for neutron absorption or form dangerously long-lived radioisotopes. If such materials are first removed from the cooling water and this is stored for a

what if your gate valves **fail?**

It is always possible that your gate valves will be called on to meet an emergency. Flood, pollution, catastrophic fire—will your gate valves *work*, and save the situation?

Because of what *could* happen, many communities insist on R. D. Wood Gate Valves. They base their preference on performance-records over the years. And the simplicity of the design inspires their confidence; for the internal mechanism contains only 3 moving parts—the spreader and discs. Free to turn on the trunnions, the discs distribute the wear rather than taking it in one place. They lift into the bonnet without drag. In closing, they are thrust from the center—from the hub—and are pushed on to their brass seats without distortion. No pockets to collect scale and sediment. When the valve is open there is an unobstructed passageway for water.

Give your community this extra measure of security. Specify the time-proved R. D. Wood Gate Valves.

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Manufacturers of Mathews Hydrants and "Sand-Spun" Pipe (Centrifugally Cast in Sand Molds)

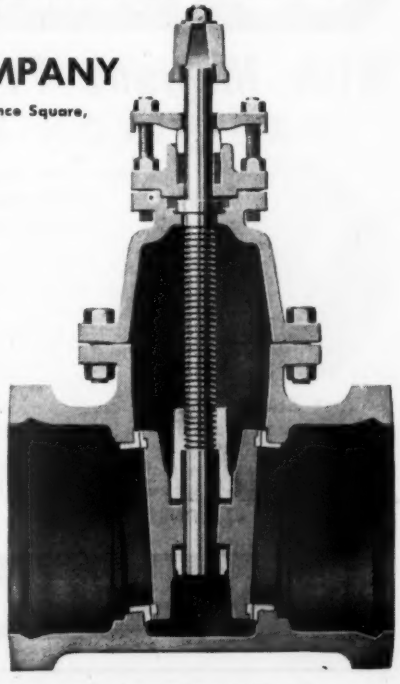
High-strength cast iron.

Fully bronze-mounted.

Rigidly inspected, tested to 300 lbs. hydrostatic pressure.

Conforming to A. W. W. A. specifications.

Sizes from 2" to 30".



When writing, we will appreciate your mentioning PUBLIC WORKS

few days, the radioisotopes of hydrogen and oxygen are almost completely disintegrated. Disposal of wastes other than water are generally buried deep in the ground or dumped at sea.

An atomic bomb explosion yields, in addition to high-intensity neutron and other radioactive radiations, large quantities of radioisotopes, some of which are fairly long-lived and might cause serious contamination of water supplies in the vicinity. A much more likely source of contamination of water supplies by bombs is the production of induced radioactivity in the water by the action of the neutrons released in the explosion on iron, calcium, sulfur and sodium in the water. As to the deliberate introduction of radioactive substances into a water supply, the large amount of such substances required to seriously affect consumers makes this impracticable.

To *prevent* contamination, the most feasible method seems to be removal of dissolved ions by ion exchange treatment, filtration and deaeration to remove CO_2. For *removing* fission products from contaminated water the ion-exchange procedure would seem to be the best available technique. It is possible that coagulation with alum would remove a large percent of the radioactive substances. Another suggestion is adding to the water a considerable amount of the element (such as iron) which has been made radioactive, but in a non-radioactive form, which would combine with that which is radioactive and all be filtered out together. Each of these methods produces a radioactive sludge, which would have to be buried or disposed of at sea. [B4]

Leaks in Water Mains

Data from 27 water systems, whose pipe lines varied from 5 miles to 4,427 miles, with a total length of 10,400 miles, showed an average of one leak per year for every 16.3 miles of mains. One city with 281 miles of mains reported no leaks in 10 years; the maximum was two miles per leak in a 9-mile system. For repairing leaks, all use recalking as one method, 14 also use bell joint clamps, and several other methods are reported. [G19]

Texas Municipal Retirement System

A statewide system for providing retirement allowances for all employees of Texas municipalities that join it went into effect last September. The fund is financed by contributions by employees of 5% of their pay, and by the municipality contributing an amount fixed by the Actuary of the board of trustees sufficient to meet the estimated liabilities but not less than that contributed by the employees. An employee must retire by his 71st year; may retire at 65, or at 60 if the municipality consents; or at 55 if he has been in active service for 25 yr. and the municipality consents. The monthly annuity paid is approximately 2½% of the average recent salary times the number of years worked, with $50 minimum and $180 maximum. If he dies or leaves city employment before retirement, his estate receives a refund of his contribution plus interest. [F23]

DDT Affects Reservoir Biological Balance

In August and September 1947 the entire city of Wilmington, Del., was sprayed with DDT by airplane, using a 30% solution in oil. This area included a 40 mg filtered water reservoir. Five days after this spraying began the water was found to contain 1200 organisms per ml, chiefly *Synedra*, which increased to 10,000 in spite of several applications of copper sulfate. Inspection of the walls of the reservoir, under water showed them to be covered with a thin coating of DDT. During the four previous Septembers the average miscroscopic counts had been 81, 51, 42 and 53, but was 5,000 in 1947. Two other reservoirs outside the area sprayed had microscopic counts similar to those of other years.

It seems safe to assume that the bio-

CUT *Installation* TIME & COST

With McWane Precalked CAST IRON PIPE

"Just Socket the Spigot and Calk"

Any man can lay McWANE PRECALKED CAST IRON PIPE

Pure lead and redwood wedges are placed in the pipe bells at the factory. All he needs to do is "socket the spigot and calk." Skill and experience are unnecessary. You'll have tight joints on corrosion-resisting, century-lasting mains.

McWANE CAST IRON PIPE CO.
BIRMINGHAM, ALA.

McWane PRECALKED Pipe

FEEDS—METERS—MIXES CHLORINE GAS ACCURATELY

PURIFICATION FOR WATER, SEWAGE AND SWIMMING POOLS—Everson SterElators Operate Manually or Semi-Automatically, Also Automatically Proportion Gas Flow to Water Flow.

Everson SterElators Utilize a 24" Water Gauge Vacuum and Visible Flow Meters, with Wide Ratio Ranges of Capacities: 10 to 1, 50 to 1, 110 to 1.

All SterElators Are Dependable, Accurate, Safe and Easy to Operate, Guaranteed to Give Complete Satisfaction.

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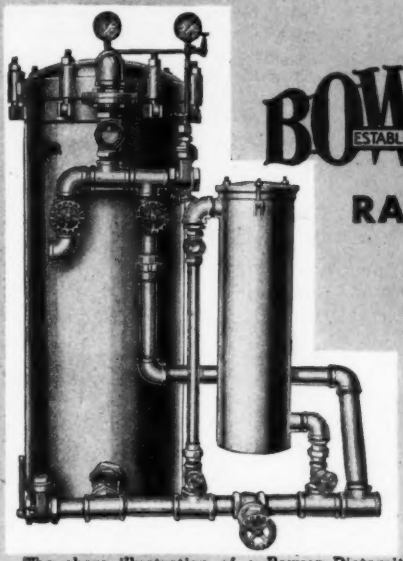
SEE EVERSON FOR THE LAST WORD IN SWIMMING POOL EQUIPMENT

213 W. HURON ST. CHICAGO, ILL., U. S. A.

When you need special information—consult the ENGINEERS' LIBRARY *on pages 77-80*

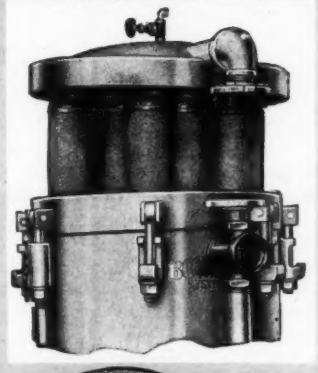


BOWSER ESTABLISHED 1885 DIATOMITE FILTRATION

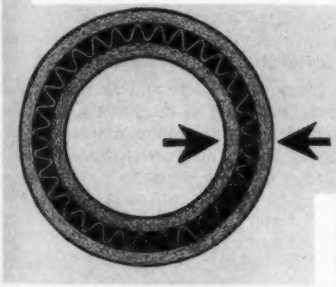
RATED BEST BY POOL ENGINEERS ON TEN *ESSENTIAL POINTS*

1. ELIMINATES COAGULANTS & ALKALI FEEDERS
2. BACKWASHES, DRAINS & PRECOATS IN 10 MINUTES
3. USES ONLY 1/10 USUAL BACKWASH WATER
4. ELIMINATES HIGH CAPACITY BACKWASH PUMPS
5. MONEL ELEMENTS LENGTHEN LIFE
6. USES STANDARD LOW COST FILTER AID
7. OCCUPIES 1/10 TO 1/5 USUAL FLOOR SPACE
8. REQUIRES NO TECHNICAL OPERATORS
9. COSTS LESS TO BUY AND OPERATE
10. FILTERS WATER CLEARER TO EXCEED HIGHEST TEST REQUIREMENTS

The above illustration of a Bowser Diatomite Filter with Precoat Pot shows the equipment, consisting of piping, valves, flow sights, unions and flanges, which is supplied standard with all sizes to provide easy and simple installation.

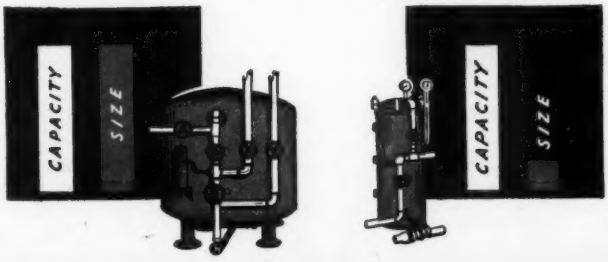


Complete accessibility is an important feature of Bowser Filters . . . for by hoisting the cover, to which the filter elements are attached, each element can be quickly detached for complete cleaning or inspection by removing the two tie-rod nuts which hold the complete assembly together.



Flow rate is increased almost double . . . and floor space to almost half that possible with single type elements. The unfiltered water flows from inside out . . . and outside in as shown by the arrows . . . the clean water flowing into the ⅜" channel and thence to the discharge manifold header.

Bowser Diatomite Filters are popular because they only require from 1/10 to 1/5 the floor space needed by conventional filters to produce an equivalent flow of clean water.



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logical balance was disturbed by the toxicity of DDT to microscopic organisms belonging to the zooplankton group, such as ameba, mastigophora, infusoria and rotifera. These organisms are natural enemies to plant life and because of their destruction *Synedra* grew freely. [A33]

Liquid Chlorine Direct From Tank Cars

The Louisville, Ky., water purification plant uses over a ton of chlorine a day and until recently had obtained this in ton containers, which were hauled a mile from railroad to plant. Trucking and the labor of loading and unloading and connecting up the tanks cost an average of $4.40 a container. In 1947 the necessary arrangements were made for obtaining the chlorine in 16-ton or 30-ton tank cars and switching these to a siding run to the plant, from which it is piped 1,000 ft. direct to the point of application. The cost of the chlorine is $6 a ton less than by the ton container, giving a total saving of $10.40 a ton, or $4,160 a year. The total cost of the installation was $3,425.

The pipe from car to point of use is 1" steel pipe, in which is an expansion loop at the car and two others along the line. All pipe joints are welded except at the expansion loops, where ammonia flange connections are used. The pipe is not insulated. Near the point of use the pipe discharges into a 150-lb. inverted chlorine cylinder in an insulated box, kept warm by means of two 100-watt lamps, this cylinder serving as a compression-expansion tank. [G18]

The Future Supply of Chlorine

The demand for chlorine is increasing. Individual users of it want more than they did before the war. There is an expanding use of it by the plastics industry. Before the war, none was used for insecticides or weed killers; now large and increasing quantities are used for 2.4-D, DDT and others. And research is continually finding new uses for it. To meet the increased demand, manufacturers are constructing new plants (which cost $80,000 per ton of daily capacity); but the capacity probably will not meet the demand before 1949 or 1950. Also there is still a serious shortage of shipping containers ranging from 100-lb. cylinders to 55-ton tank cars, so that not all the production now available can be utilized.

Prices are increased by certain practices, such as requiring prices guaranteed for a year, prices delivered, and use of the wrong type of container. [X14]

Progressive Improvement in Water Purification at Wheeling

Since the purification plant of Wheeling, W. Va., was installed in 1925, increasing pollution of the Ohio river has necessitated improvements in the treatment process. Until 1933 no effort was made to control tastes and odors; lime and alum were used as coagulants, and chlorine to produce 0.1 ppm residual; there was no typhoid, but the water was undrinkable nearly half the time.

Since 1933 lime and ferrous sulfate have been used as coagulants. For taste control, chlorine-ammonia was used for 2 years with fair results. From 1935 to 1939, chlorine-ammonia plus carbon and also silicate of soda gave fairly good water 70% of the time, but large phenol slugs in the river made the taste terrible. This was remedied by breakpoint in 1940-42, until a butadiene plant started operation 60 miles up the river, when superchlorination and dechlorination with sulfur dioxide and carbon were employed, also the split lime treatment, and gave good results 90% of the time. Since 1943 superchlorination, aeration and the addition of 10% well water has been employed, with sodium bisulfite when needed to keep the residual chlorine down to 2 ppm; result, an organic free, pyrogen free, sterile water with good taste 99% of the time. Cascade aeration effected little odor removal, but 85% reduction was obtained by blowing air through the water at the rate of 0.8 cu. ft. per gal. The well water, which has a total

Builders new Chronoflo Sequence System brings substantial savings to long distance telemetering. A single telephone circuit now transmits up to six sets of information from Builders Chronoflo Transmitters, — water level, temperature, pressure, flow, etc. — centralizes control of remote pumps and equipment, and, with reduced personnel, provides round-the-clock operational data from outlying stations.

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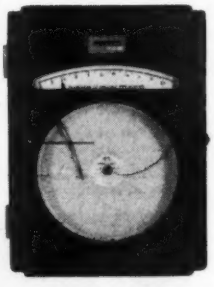

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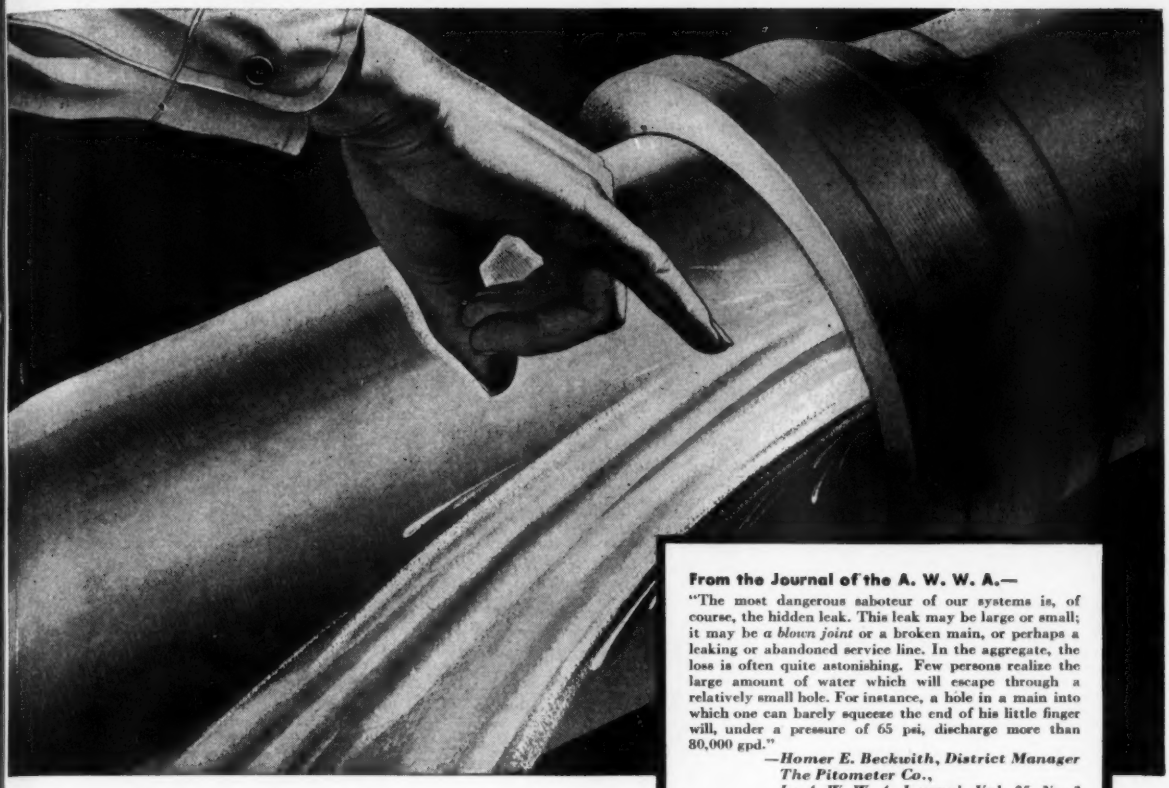

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With the adjustable Dresser Style 60 Clamp, you get a permanent seal—even on off-size pipe. You get a flexible, reinforced joint that can live in the ground, secure against the hazards of settlement, vibration and other movement. You "fix it once—fix it for good".

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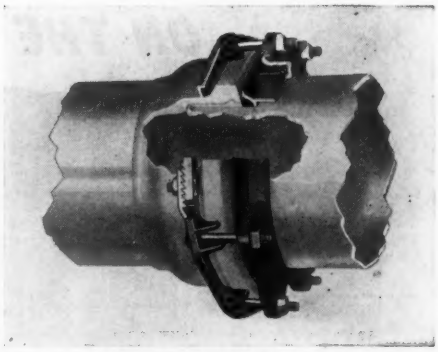

Cutaway view shows how Style 60 Clamp stops leaks and reinforces the joint. Note how far gasket extends up bell face and along spigot for positive protection. Serrations on bell ring, clips and fillers on spigot ring, provide wide range of adjustability.

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alkalinity of 300 ppm, brings that of the finished water from 12 to 30 ppm, making the water less corrosive and better tasting.[F20]

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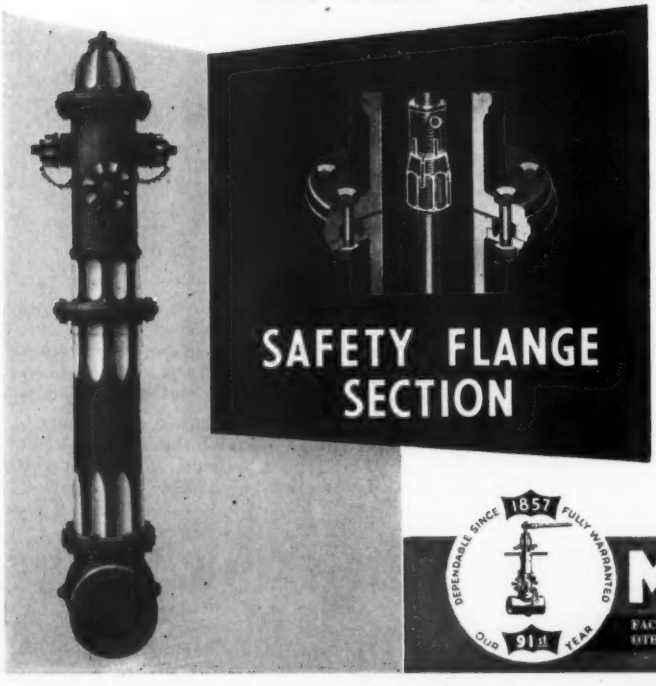

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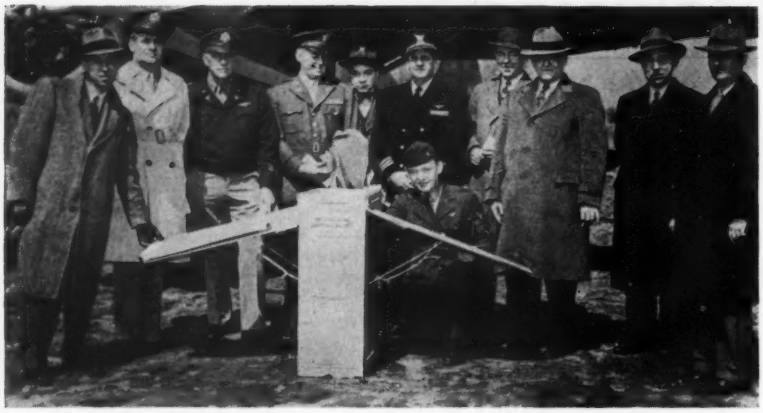

Your Editor personally craves more wings than this carton has.

Winged Carton for Air-Borne Disaster Relief

Successful tests have been made of a special winged carton, designed to deliver calcium hypochlorite by air to communities isolated by floods. The carton, which requires no parachute, will carry six five-pound cans of the chemical, enough to purify up to 2½ million gallons of drinking water, depending on the degree of contamination. The *Mathieson Chemical Corp.*, N. Y., makers of the unit, advise that stocks of the winged cartons be maintained at key locations in areas subject to floods.

Huber's new berm leveler.

A Berm Leveler for Maintenance

For berm maintenance on hard surfaced roads, this unit is provided with a hydraulic control so that excess material can be moved from berms and feathered out as desired. The berm leveler is mounted on the rear of the maintainer. This one-man operated unit has a reversible assembly to permit boulevard and divided highway maintenance. Full information and data from *Huber Mfg. Co., Marion, Ohio.*

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Lapp Pulsafeeders Now Available

A new line of Pulsafeeder proportioning pumps, the CP models, has been announced. Four sizes are available, No. 1 for flows from 0 to 11 gals. per hr.; No. 2, up to 40 gph.; No. 3, up to 100 gph.; and No. 4, up to 330 gph. Duplex, triplex and other multiple-head arrangements are available for continuous blending or feeding. These are combination piston-diaphragm pumps, micro-adjustable over the entire capacity range while the pump is in operation. *Lapp Insulator Co., Inc., LeRoy, N. Y.*

Cla-Val Co. Purchases Valve Division of Clayton

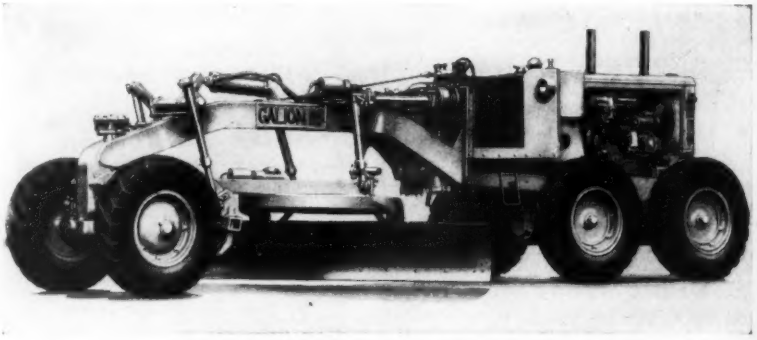
The Cla-Val Co., PO Box 949, Alhambra, Calif., has purchased the manufacturing and other rights of the Valve Division of the Clayton Mfg. Co., and is now operating as an independent organization with H. B. Pearce as Sales Manager.

Concrete Cutter and Scorer

This concrete cutter is useful on all kinds of pavements and floors. It cuts with a diamond saw to depths of 3 ins. It requires only one man to operate and saves plenty of time in street and highway repair, opening trenches, and similar work. Cuts up to 60 ins. a minute, with sharp straight edges and 90° angles at the corners. Ask for data from *Backlin Products Co., Dept. PW, Burlington, Wisc.*

Extra Heavy Duty Grader

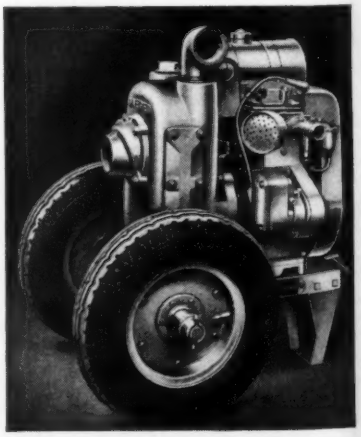
The Galion Model 116 is designed and constructed to handle the heaviest and toughest kind of work. This new machine is powered with a 100 hp. diesel engine, and weighs between 23,285 lbs. and 25,050 lbs. depending on extra equipment. Eight forward speeds range from 1.5 to 26.0 miles per hour. Precision controls permit grading to exact specifications. *Galion Iron Works & Mfg. Co., Galion, Ohio.*



New Galion heavy duty No. 116 motor grader.

Portable High Pressure 2-inch Pump

This new pump weighs only 150 lbs., but will discharge 30 to 135 gpm. at various heads. It has a trash-type impeller and is built of salt-water-resistant aluminum alloy. It has a 5 hp. Wisconsin air-cooled engine. For full information write *Jaeger Machine Co., Columbus 16, Ohio.*



New Jaeger pump.

For more information about these products, write direct or use coupon on page 43

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Have You a Deep Well Pumping Problem?

455. Peerless deep well pumps in a variety of types, with oil or water lubrication and any power drive, to pump water from any depth are subject of special bulletins. Write Peerless Pump Div., Food Machinery Corp., 301 W. Ave. at 26th St., Los Angeles 31, Calif.

Pittchlor for Water Treatment

503. Get your illustrated booklet P.W. now on *Pittchlor*, a high test calcium hypochlorite, containing minimum 70% of available chlorine. Address, Pittsburgh Plate Glass Co., Columbia Chemical Div., 5th Ave. at Bellefield, Pittsburgh 13, Pa.

For Completely Successful Trickling Filter Systems

562. There's a vitrified clay filter bottom block to fit every shape tank. These blocks can be laid quickly and easily by unskilled labor. For more information, full details, specifications and list of typical plants write any firm listed below: Metropolitan Paving Brick Co...Canton, O. National Fireproofing Corp. Pittsburgh 12, Pa. Ayer-McCarel-Reagan Clay Co..Brazil, Ind. Bowerston Shale Co.....Bowerston, Ohio

Complete Data on Digester Accessories and Sewage Gas Controls

563. Sewage gas controls, flame traps, waste gas burners, regulators, condensate and sediment traps and other equipment for utilizing and safe control of sewage gas are described and illustrated in catalog PWS-3. For copy of this catalog write to The Vapor Recovery Systems Co., 2820 No. Alameda Street, Compton, Calif.

You Need This Useful Pump Data

564. For complete data on sewage and trash pumps, both vertical and horizontal centrifugals for pumping sewage and sludge ask for bulletin PW 6202. For data on plunger type sludge pumps ask for bulletin 6300. For either or both write: Yeomans Bros. Co., 1409 N. Dayton St., Chicago 22, Ill.

How to Save Wood From Decay and Termites

565. If you have decay or termite problems or want to prevent them get the facts today by writing for ths 32-page biooklet telling all about Pentachlorophenol. Write to the Dow Chemical Company, Midland, Mich., asking for booklet No. PE 49.

Portable Mixer for Any Cold Mix

567. For bulletin describing this portable mixer that will handle up to 3 cubic feet of any cold mix on an entirely new principle write to The Foote Company, Inc., 1954 State St., Nunda, N. Y.

New Versatile Power Grader

569. The Austin-Western 99-H power grader features all-wheel drive, all-wheel steer, high-lift blade, extreme reach and completely reversible blade. For folder describing, illustrating and giving specifications write to the Austin-Western Company, Aurora, Ill.

Concrete Forms For Every Need

608. There's a form for your need whether it's concrete pipe for sewer, drain or irrigation; forms for roads, bridges, tunnels or manholes; or a special form problem. For folders telling just what these concrete forms can do for you write Dept. PW, Concrete Forms Corp., 43 Cedar Street, New York 5, N. Y.

Diesel and Dual Fuel Engines

609. Facts, figures, illustrations and specifications on these engines are covered in an attractive series of booklets; yours for the asking. Address Worthington Pump & Machinery Corp., Harrison, N. J.

Saving Money by Cleaning Water Mains

610. This is the theme of an 8-page booklet that every water works executive ought to have. Gives results, figures, and new light on an old problem. Titled "Let's Look into This Matter." Address: National Water Main Cleaning Co., 50 Church Street, New York 7.

Want to Keep Swimming Pools Safe and Sanitary?

611. Such is the title of important 42-page illustrated booklet suggesting solutions to many common problems of swimming pool sanitation and operation. Just address: Mathieson Alkali Works (Inc.) Dept. PW, 60 East 42nd St., New York 17.

Road Protection at Less Cost

612. There's no limit to the jobs you can handle with an Allis-Chalmers Package outfit consisting of the HD-5 Tractor with Tracto-Shovel and Model A-D Motor Grader. For booklets describing and illustrating these and other Allis-Chalmers Equipment write Dept. PW, Allis-Chalmers Tractor Division, Milwaukee 1, Wisc.

How Elevated Water Tanks Can Save on Operating Costs

613. Beautiful new booklet on Horton elevated steel water tanks suggests ways to reduce pumping costs, increase capacity of systems, maintain uniform pressure, etc. Illustrates 7 models of welded, ellipsoidal-bottom, elevated steel tanks in full color. Write Chicago Bridge & Iron Co., 2115 McCormick Bldg., Chicago 4.

Time for a New Transit Level?

614. Two are described in attractive illustrated folders. One, the Warren-Knight, is "used like a transit, checked like a level." Another, the Sterling Convertible Level. Investigate free trial offer. Use coupon or address Warren-Knight Co., 136 No. 12th St., Philadelphia, Pa.

Long Distance Recording of Level-Pressure-Flow

615. Be sure to get Bulletin 358 on the "Chronoflo Telemeter" that brings accurate records of flow, level, pressure, temperature, gate positions, weight, etc., from widely scattered locations to a central operating point. Widely used in Water and Sewage plants. Write Builders-Providence, Inc., 16 Codding St., Providence 1, R. I.

The Modern Way to Filter Swimming Pool Water

616. That's the title of a new bulletin full of facts about Bowser's new diatomite filter to produce clear, sparkling, clean water at low cost. Occupies small space, doesn't waste water. Gives sizes to use, performance charts, etc. Write Bowser, Inc., Dept. PW, Ft. Wayne, Ind.

Data on All Types of Universal Concrete Pipe

617. New bulletin gives facts about reinforced and non-reinforced Universal Concrete Pipe for sewers, culverts, acid resisting lines, underpasses, etc. Also covers site cast pipe. Universal Concrete Pipe Co., Dept. PW, 297 South High St., Columbus 15, Ohio.

Reduce Your Mowing Time With a Power Mower

618. The Millner Master Mower is ideal for cutting the tallest grasses and weeds quickly and thoroughly. Will cut a 24 inch swath and cuts right up to trees, shrubs and fences. For complete information and the name of your nearest dealer write Millner Products Company, Dept. PW, Barnett-Madden Bldg., Jackson, Miss.

Hydraulic Dump Bodies For Every Purpose

619. There's a hydraulic hoist or dump body designed and built to fill your need. Hercules bodies are designed to do a specific job in less time and at a lower cost. Specifications and data on the complete Hercules line available without obligation by writing to Dept. PW, Hercules Steel Products Corp., Galion, Ohio.

Flow Meters with Many New Features

620. The new "Propelofio" meter for main-line metering introduces many new features you will want to look into. Streamline Venturi design results in exceptional accuracy. Send for latest bulletin today. Builders Providence, Inc., 16 Codding St., Providence 1, R. I.

A New Answer to Some Old Waterworks Problems

621. That is what they call "Hypo-Chlorination of Water," a 75-page illustrated discussion of this live subject, in a booklet packed with helpful information. For your copy, address: Mathieson Chemical Corp., Dept. PW, 60 E. 42nd St., New York 17, N. Y.

All About Cement-Mortar Lining of Water Mains

622. Here, in a really beautiful booklet, is practically everything you need to know about this method of lining mains in place—the needs, methods, and results that will interest you. Centriline Corp., Dept. PW, 140 Cedar St., New York 6, N. Y.

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CONSTRUCTION AND MAINTENANCE

Speed Maintenance With This Portable Air Compressor

1. LeRoi Portable compressors in sizes from 60 to 500 c.f.m., gasoline or Diesel powered on mountings to fit your special needs. Same manufacturer makes both compressor and engine. Complete bulletin. Write LeRoi Company, 1770 So. 68th St., Milwaukee 14, Wis.

Solve Your Drainage Problems This Easy, Permanent Way

70. Useful new 60 page catalog on standard corrugated pipe, multi-plate pipe and arches and 18 other drainage and related products for culverts, sewers, subdrains, flood control, airports, water supply and other types of construction. Ask for "Armco Products for Engineering Construction," Armco Drainage and Metal Products, Inc., Dept. PW, Middletown, Ohio.

Reliable Every Purpose Pumps

117. New brochure by Gorman-Rupp Co., Mansfield, Ohio, illustrates and describes many of the pumps in their complete line. Covers heavy duty and standard duty self-priming centrifugals, jetting pumps, well point pumps, triplex road pumps and the lightweight pumps.

Data and Pictures of Complete Line of New Ford Trucks

532. Full line of new Ford Trucks for 95% of all hauling needs is pictured in colorful circular — Light Duty, One-Ton, Heavy-Duty and C. O. E. trucks. Also 48 out of over 100 standard, factory built chassis and body combinations. See before you buy. Write for your copy now. Truck and Fleet Sales Dept., Ford Motor Co., Dearborn, Mich.

Two-Way FM Radio Telephone Equipment for All Departments

541. For booklet describing and illustrating the Motorola Two-Way Radio Telephone or for specific recommendations concerning your aplication write to Dept. PW, Motorola, Inc., 4545 Augusta Blvd., Chicago 51, Ill.

Power Mower for Water Works, Sewage Plants, Highways, Etc.

553. For cutting the grass around your Water and Sewage plants and removing weeds and tall brush along your highways the Jari power scythe is just the thing you need! For a booklet describing this mower which is said to be easy to handle, economical to operate, fast and clean around trees and can be handled by one man write Dept. PW, Jari Products, Inc., 2936-F Pillsbury Ave., Minneapolis 8, Minn.

Diesel Engines to Help You Build Profits

560. A new 28 page catalog just off the press titled "Superior Stationary Diesel Engines," is packed with facts that will help you build profits. For your copy write to Superior Engine Division, National Supply Company, Springfield, Ohio.

SNOW FIGHTING

For High-Speed Snow Removal

350. "Frink One-Way Sno-Plows" is a four page catalog illustrating and describing 5 models of One-Way Blade Type Sno-Plows for motor trucks from 1½ up to 8 tons capacity. Interchangeable with V Sno-Plow. Frink Sno-Plows, Inc., Clayton, 1000 Islands, N. Y.

STREETS AND HIGHWAYS

How to Use Less Labor in Resurfacing

15. You can mechanize your resurfacing with these Portable Bituminous Mixers, 6 to 14 ft. sizes for resurfacing and maintenance. Helpful booklet issued by The Jaeger Machine Co., 400 Dublin Avenue, Columbus 16, Ohio.

Speed Your Work With These Powerful Motor Graders

128. Two powerful Galion motor graders designed to answer every requirement for more speed in road, airport, dam and housing construction work are fully described in a folder illustrated with many action pictures. Issued by Galion Iron Works & Mfg. Co., Galion, Ohio.

Here's a Roller for Every Need

141. Three-Wheel and Tandem Rollers, 5 to 8-ton and 10 & 12 ton sizes: also variable weight tandem roller for new highway surfacing and old road conditioning. Ask for new bulletin. Dept. P.W., Huber Mfg. Co., Marion, Ohio.

Here's Your Diesel Tractor!

190. Big 48 page catalog describes and lists many uses for International Diesel Tractors. Write International Harvester Co., Dept. P.W., 180 North Michigan Ave., Chicago 1, Ill.

Latest Maintenance Equipment For Blacktop Roads

290. "Blacktop Road Maintenance and Construction Equipment" — Asphalt and tar kettles, flue type kettles, spray attachments, tool heaters, surface heaters, road brooms and rollers. This is modern and up-to-date equipment for blacktop airport

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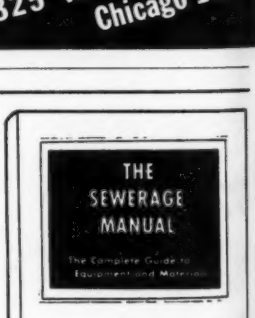
A great help in working up plans for sewage disposal

This Manual describes every type of equipment and material available for use in sewage disposal and sewer construction. Used by leading Sanitary Engineers everywhere when preparing plans. It is the standard source of unbiased information. If you don't have a copy of the 1947-48 edition, write today for information on how to obtain one.



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and road construction and maintenance. Write for Catalog R. Littleford Bros., Inc., 452 East Pearl St., Cincinnati 2, Ohio.

Need Street, Sewer or Water Castings?

429. Street, sewer and water castings in various styles, sizes and weights. Manhole covers and steps, inlets and gratings, adjustable curb inlets, water meter covers, cistern and coal hole covers, gutter crossing plates, valve and lamphole covers, etc. Described in catalog PW issued by South Bend Foundry Co., South Bend 23, Ind.

Practical Portable Power Units for Every Need

533. M-M power units with heavy duty engine, positive lubrication, easy servicing, handy controls may be just what you have been looking for. Simple, durable, practical. Get latest bulletin from Dept. PW., Minneapolis Moline Power Implement Co., Minneapolis 1, Minn.

SEWAGE DISPOSAL

Non-Corrosive, Long Lasting Low Cost of Sewer Pipe

72. Get this new engineering data on clay pipe for sewers. Withstands acid, alkali and gas attacks indefinitely. Cuts maintenance costs to a minimum. Write Dept. P.W., National Clay Pipe Mfrs., 111 W. Washington St., Chicago 2, Ill.

Does Air Sabotage Your Pipe Lines and Pumps?

357. Automatic Air Release Valves for water, sewage and industrial uses automatically vent air accumulations. Ask for latest illustrated engineering bulletins. Simpex Valve & Meter Co., 6750 Upland St., Philadelphia 42, Pa.

Valuable Booklet on Porous Diffuser Plates and Tubes

367. A valuable booklet on porous diffuser plates and tubes for sewage treatment plants. Covers permeability, porosity, pore size and pressure loss data, with curves. Also information on installations, with sketches and pictures, specifications, methods of cleaning and studies in permeability, 20 pp. illustrated. Write to Norton Company, Dept. P.W., Worcester 6, Mass.

Do Your Water Mains Need Cleaning?

388. Literature on Flexible method of cleaning water mains any size from 2" to 72", giving full details and list of nearest representatives in all parts of country. Address: Flexible Underground Pipe Cleaning Co., 9059 Venice Blvd., Los Angeles, Calif.

Solve Corrosion Problems With This Special Alloy

391. "Everdur Metal" is title of an 8-page illustrated booklet describing advantages of this corrosion-resisting alloy for sewage treatment equipment, reservoir, and waterworks service. Dept. P.W., the American Brass Co., 25 Broadway, N. Y. C.

How to Make Concrete Pipe on the Job

440. Making concrete pipe on the job with local labor is the subject of a booklet sent on request by Quinn Wire & Iron Works, 1621 12th St., Boone, Ia., manufacturers of "Heavy Duty" Pipe Forms.

Concrete Pipe With Greater Elasticity

442. Lock Joint Reinforced Concrete Sewer Pipe, Pressure Pipe, Culvert Pipe, Centrifugal Pipe and Subaqueous Pipe is described and illustrated in bulletins available from Lock Joint Pipe Co., Ampere, N. J.

How to Make Better Sewer Pipe Joints

447. How to make a better sewer pipe joint of cement—tight, minimizing root intrusion, better alignment of joint. Permits making joints in water-bearing trenches. General instructions issued by L. A. Weston, Dept. P.W., Adams, Mass.

Save Trucks and Labor In City Rubbish Collection

459. For saving trucks, labor, and time in city rubbish collection get details of the new Dumpster-Kolector described in literature just published by Dempster Brothers, Inc., 996 Higgins, Knoxville 17, Tenn.

Ask for This Design Data On Sprinkling Filters

469. Design data on sprinkling filters of Separate Nozzle Field and Common Nozzle Field design as well as complete data on single and twin dosing tanks, and the various siphons used in them, for apportioning sewage to nozzles. Many time-saving charts and tables. Write Pacific Flush Tank Co., Dept. P.W., 4241 Ravenswood Ave., Chicago 13, Ill.

Design Details for Sludge Collectors

480. Booklet No. P.W. 1642 on Link-Belt Circuline Collectors contains sanitary engineering data and design details. Catalog No. 1742 on Straightline Collectors, contains layout drawings, installation pictures and capacity tables. Address Link-Belt Co., 2045 West Hunting Park Ave., Philadelphia 40, Pa.

How the Hydro-Treator Works

486. 28-page catalog describes and illustrates the Dorrco Hydro-Treator, a self-contained water treatment unit combining Flocculation, Sludge Thickening and Clarification. Reduces treatment time and lowers plant construction costs. The Dorr Co., Dept. P.W., 570 Lexington Ave., New York 22, N. Y.

Packaged Sewage Treatment—Just Right for Small Places

488. "Packaged" Sewage Treatment Plants specifically developed for small communities — 100 to 3,000 population. Write for full description and actual operating data for this type of plant. Chicago Pump Co., 2348 Wolfram St., Chicago 18, Ill.

Need Equipment for Small Sewage Plant?

491. Small type Conveyor Sludge Collector and Skimmer, Grit Collector, Aero-Filter and other equipment for small sewage treatment plants are described and illustrated in bulletins from Chain-Belt Co., 1722 West Bruce St., Milwaukee 4, Wis.

How to Stabilize Lime Softened Water

498. Engineering Bulletin describes stabilizing lime-softened water by recarbonation, discusses gas production, washing, compressing, drying, and applying the CO_2. Infilco, Inc., 325 West 25th Place, Chicago 16, Ill.

Engineering Details of Armcre Filter Blocks

525. Engineering bulletin shows construction details of Armcre Filter Bottom Blocks for better trickling filter results. Tells how Armcre blocks meet all requirements. Write to Ayer-McCarel-Reagan Clay Co., Brazil, Ind.

Need Low-Cost Air For Sewage Treatment?

602. New booklet on Centrifugal and Rotary Positive Blowers engineered to fit your needs: air for activated sludge; constant vacuum for filters; priming centrifugal pumps; measuring sludge gas; water treatment. Write Roots-Connersville Blower Corp., 712 Poplar Ave., Connersville, Ind.

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WATER WORKS

Hydraulic Pipeline Scraper For Water and Sewage Mains

382. For a copy of this compact folder on a hydraulic pipeline scraper which cleans all kinds of mains from 4 inches to 14 inches write to Dept. PW, Carver-Stimpson Pipe Cleaning Co., Walters, Okla.

To Measure, Mix, Feed Chlorine or Other Gases

397. Everson SterElators. Bulletins 1063, 1066, 708 and others describe this device for measuring, mixing and feeding chlorine or other gases in solution. Capacities range from ¼ lb. to 2,000 lb. of gas per 24 hours. Address: Everson Manufacturing Co., 214 W. Huron St., Chicago 10, Ill.

Make Water Extra Safe

399. Safe water may be one of the civic improvements your citizens expect soon. Feeders of all types including Hypochlorinators, Reagent Feeders, Dry Chemical Feeders, Chlorinators and Ammoniators for feeding all of the usual chemicals used in sanitation practice. Ask for latest catalogs. Dept. P.W., Wallace & Tiernan Co., Newark 1, N. J.

Chem-O-Feeders for Automatic Chemical Feeding

400. For chlorinating water supplies, sewage plants, swimming pools and feeding practically any chemical used in sanitation, treatment of water and sewage. Flow of water controls dosage of chemical; reagent feed is immediately adjustable. Starts and stops automatically. Literature from % Proportioneers, Inc. %, 96 Codding St., Providence 1, R. I.

All Types of Valves, Hydrants And Fittings

413. Gate, flap and check valves; floor stands and fittings. New catalog No. 34 gives detail information with dimensions for all types of new full line. M. & H. Valve & Fittings Co., Aniston, Ala.

Complete Data on Gates, Valves, Hydrants

414. Gate Valves. Double disc bronze mounted, sizes 2" to 72", hand, hydraulic, electric or pneumatic operating, rising or

non-rising stem. Bulletin X. Address: Rensselaer Valve Co., Troy, N. Y.

What You Should Know About Meter Setting and Testing Equipment

431. The most complete catalog we have seen on setting and testing equipment for water meters—exquisitely printed and illustrated 48-page booklet P.W. you should have a copy of. Ask Ford Meter Box Co., Wabash, Ind.

Do You Have This Data On Cast Iron Pipe?

438. "Cast Iron Pipe and Fittings" is a well illustrated 44 page catalog giving full specifications for their complete line of Sand Spun Centrifugal Pipe, Fire Hydrants, Gate Valves, Special Castings, etc. Will be sent promptly by R. D. Wood Co., Dept. P.W., Public Ledger Building, Independence Square, Philadelphia 5, Pa.

Interesting Facts About Transite Pipe

445. Two new illustrated booklets, "Transite Pressure Pipe" and "Transite Sewer Pipe" deal with methods of cutting costs of installation and maintenance of pipe lines and summarize advantages resulting from use of Transite pipes. Sent promptly by Johns-Manville Corp., Dept. P.W., 22 East 40th St., New York 16, N. Y.

Need a Water-Tight Pipe Joint?

449. Full information on "Hydro-Tite" jointing compound for bell and spigot pipe, together with specifications, instructions; and illustrations both on it and "Fibrex" sanitary joint packing are contained in handsome 48-page booklet. Address: Hydraulic Development Corp., Dept. P.W., 50 Church St., New York.

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Data on High Efficiency Well Water Systems

454. Installation views and sectional scenes on Layne Vertical Centrifugal and Vertical Turbine Pumps fully illustrated and including useful engineering data section. Layne Shutter Screens for Gravel Wall Wells. Write for descriptive booklet P.W., Adv. Dept., Layne & Bowler, Inc., Box 186, Hollywood Station, Memphis 8, Tenn.

Oil or Water Lubricated Turbine Pumps

456. Oil lubricated turbine pumps with open impellers. Five types of heads available. Specifications and illustrations in new bulletin 6930M-2 issued by Fairbanks, Morse & Co., Dept. P.W., 600 So. Michigan Ave., Chicago 5, Ill.

Here's Data on All Kinds of Pumps

458. Performance data and illustrations on all kinds of pumps for all uses. Address: Dept. P.W., American Well Works, Aurora, Ill.

Want Clear, Soft, Iron-Free Water?

467. Water Softening. The use of the Spaulding Precipitator to obtain maximum efficiency and economy in water softening is described in this interesting technical booklet. Permutit Co., Dept. P.W., 330 W. 42nd St., New York 18, N. Y.

Are You Thinking About A Swimming Pool?

472. Data and complete information on swimming pool filters and recirculation plants; also on water filters and filtration equipment. For data, prices, plans, etc., write Roberts Filter Mfg. Co., 640 Columbia Ave., Darby, Pa.

Treating Water With Copper Sulphate

496. "Use of copper sulphate in water treatment plants" contains valuable data on chemicals, dosage, etc. Ferri-floc Ferric Sulphate—a new, valuable booklet P.W. on coagulation for water and sewage treatment plants. Write Tennessee Corporation, Atlanta 1, Ga.

Outdoor Water Service Devices That Do Not Freeze

506. Data on anti-freeze outdoor drinking fountains, hydrants, street washers, etc., contained in Catalog L. Sent promptly on request to Murdock Mfg. & Supply Co., 426 Plum St., Cincinnati 2, Ohio.

Find Buried Pipe and Leaks

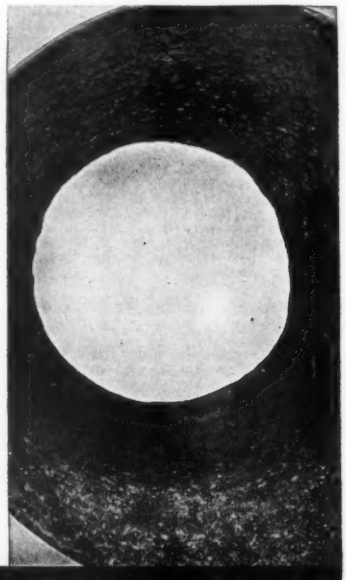
545. Finding Buried Pipe, Leaks is easy with the new Featherweight Goldak Pipe Locator. An easy-to-read illustrated bulletin tells the full story quickly. Address: The Goldak Co., 1544 W. Glenoaks Blvd., Glenade 1, Calif.

Tired of Digging at Random?

555. There's a better way to locate leaks or "lost" pipe, valves, etc. New literature showing latest models of Pipe Finders, Leak Locators, etc., is offered free by Fisher Research Laboratory Inc., 1961-65 University Ave., Palo Alto, Calif.

With seven miles of badly corroded 36" and 48" steel pipe up for replacement at an estimated cost of $1,800,000., the City of Montreal reconditioned the entire line at a total cost of only $205,000. — a saving of $1,595,000.

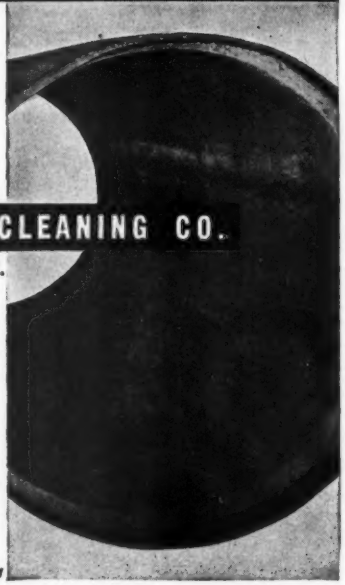
Reconditioning included a thorough cleaning and removal of incrustation and debris by the National Water Main Cleaning Co. after which the cleaned surface was centrilined. Final results indicate reduced friction losses, improved carrying capacity and permanent protection against leakage and internal corrosion.



cleaning and reconditioning water main
SAVES MONTREAL $1,595,000

Why not let our engineers find out if similar savings can be effected in your city? No obligation of course!

25



NATIONAL WATER MAIN CLEANING CO.

50 CHURCH STREET, NEW YORK 7, N. Y.

ATLANTA
1221 Mortgage Guarantee Building
BOSTON
115 Peterboro Street
CHICAGO
205 West Wacker Drive
HOUSTON
2510 Grant Street
KANSAS CITY
421 BMA Building
LOS ANGELES
448 South Hill Street
MEMPHIS
822 Dermon Building
OMAHA
3612 Castellar Street
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ST. LOUIS
7103 Dale Avenue
SALT LAKE CITY
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SAN FRANCISCO
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2020 Union Avenue
VANCOUVER, B. C.
505 West 1st Avenue
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WINNIPEG
370 Wall Street
HAVANA -
MAYAGUEZ, PUERTO RICO
BOGOTA-CARACAS-MEXICO CITY

A Super Booklet on Elevated Water Tanks

The Chicago Bridge & Iron Co., 332 South Michigan Ave., Chicago, Ill., has published a most unusual bulletin describing the use and advantages of ellipsoidal-bottom elevated water tanks of welded construction to provide gravity water pressure in municipal water systems. This bulletin has beautiful illustrations of seven different sizes of tanks in natural colors, plus a page of construction details. Copies will be sent to municipal and water works engineers and officials on request. It's really worth while.

Job Training Pamphlets

Two training pamphlets have been issued by Caterpillar Tractor Co., Peoria, Ill., "Trained Men" and "College Graduate, Where Now?" The first-named is pointed to the 4-year machinist, foundryman and patternmaker apprentice course; the 2-year machine shop, welding and business training courses; the engineering cooperative training course in which trainees alternate at Caterpillar and at engineering college; and the college graduate course. This latter course is outlined in greater detail in "The College Graduate."

Peerless Vertical Turbine Fire Pumps Approved

Full approval of the Underwriters' Laboratories, Inc., and Associated Factory Mutual Fire Insurance Companies has been granted the Peerless vertical turbine fire pumps. These have capacities of 500 to 2,000 gpm through heads of 240 to 285 ft.

Florida Water & Sewerage Short Course

The 16th annual short course and conference on water supply and sewerage will be held at the University of Florida, Gainesville, Fla., June 7-12. Full information on the program can be obtained from G. M. Turner, assistant dean, General Extension Division, Siegle Bldg., Gainesville.

North Carolina Water Works Operators' School

This school will be held at Chapel Hill, N. C., June 7 to 11. A full program can be obtained from Clifford Pace, assistant director, Institute of Government, Chapel Hill, N. C. The preliminary program shows an exceedingly fine program for instruction by groups depending on previous training.

Metropolitan Section, NYSSWA

A Metropolitan Section of the New York State Sewage Works Association has been formed. Arthur J. Scanlon and Anton E. Sparr, both operators in New York City sewage treatment plants; A. J. Fischer, Paul Cerny, W. A. O'Leary and Morris Klegerman are members of the executive committee. Arthur Scanlon is chairman of the section. Meetings are being held at the City Health Department Office, 125 Worth St., N. Y.

Other Meetings

The Pennsylvania Water Works Operators' Ass'n., will hold its annual meeting at State College, Pa., Aug. 23-25. I. M. Glace, 1001 Front St., Harrisburg, Pa., is secretary-treasurer. The Sewage Works Operators' meeting will follow immedately thereafter.

The Iowa Sewage Works Association will meet Sept. 14-15 at the Kirkwood Hotel, Des Moines, Iowa. Leo Holtkamp, Box 310, Webster City, Ia., is secretary.

The 21st annual meeting of the Federation of Sewage Works Associations will be held in Detroit, Mich., Oct. 17-21. Headquarters for the meeting will be the Statler. Chairman of the local arrangements committee is W. H. Wallace, Supt. of Filtration and sewage treatment at Detroit.

The South Dakota Water & Sewage Works Conference will be held in Sioux Falls, S. D., Sept. 30 and Oct. 1. W. W. Towne, Pierre, S. D., is secretary.

The Southwest Section, AWWA, will meet in Oklahoma City, Okla., Oct. 9 to 12. L. A. Jackson, Robinson Memorial Auditorium, is secretary.

For the Utmost in Turbine Pump UTILITY AND CAPACITY

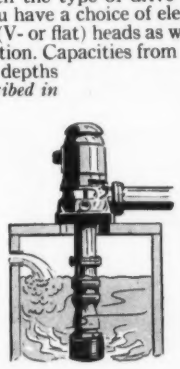
PEERLESS Vertical Turbine PUMPS

PEERLESS Builds a Pump to Suit Your Service—Capacities: 15 to 30,000 G.P.M.

PEERLESS VERTICAL TURBINE PUMPS FOR DEEP WELL SERVICE

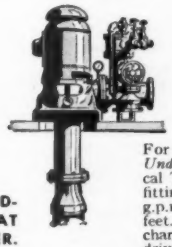
For development of a reliable, permanent water supply, install these deep well pumps with the type of drive most suitable to your application. You have a choice of electric, right angle gear drive, or belted (V- or flat) heads as well as the option of oil or water lubrication. Capacities from 15 to 30,000 g.p.m. are obtained from depths of 1000 feet or more. *Fully described in Peerless Bulletin B-141-1.*

PEERLESS CLOSE-COUPLED TYPE VERTICAL TURBINE PUMPS



For pumping from short settings such as pits, sumps and surface water sources, such as lakes, rivers and ponds, get the full utility and capacity of a deep well pump with a close-coupled Peerless Vertical Turbine Pump. Makes an extremely compact installation. Uses include cooling tower service, boosting, recirculation and dewatering. Capacities: up to 30,000 g.p.m. *Fully described in Bulletin B-159.*

PLAN YOUR PUMP REQUIREMENTS WITH PEERLESS— PEOPLE WHO CARE



PEERLESS VERTICAL TURBINE APPROVED FIRE PUMPS...

For adequate fire protection, the *Underwriters' approved* Peerless Vertical Turbine Fire Pump, with proper fittings, produces from 500 to 2000 g.p.m. against heads from 240 to 285 feet. Built for instant operation. Discharge piping is simplified. Choice of drives and oil or water lubrication. *Fully described in Bulletin B-152.*

DISCOVER ALL THE ADVANCED FEATURES THAT PEERLESS PUMPS OFFER. • REQUEST BULLETINS •

PEERLESS PUMP DIVISION

Food Machinery Corporation

Factories: Los Angeles 31, Calif.; Quincy, Ill.; Indianapolis, Ind. *District Offices:* New York 5, 37 Wall Street; Chicago 40, 4554 North Broadway; Atlanta Office: Rutland Building, Decatur, Georgia; Dallas 1, Texas; Fresno, Calif.; Los Angeles 31, Calif.

fmc PEERLESS PUMPS

When you need special information—consult the ENGINEERS' LIBRARY *on pages 77-80*

THE NAMEPLATE OF DEPENDABILITY

WATER FILTRATION PLANTS AND EQUIPMENT • ZEOLITE SOFTENERS WHEELER FALSE FILTER BOTTOMS PRESSURE FILTERS • SPECIAL WATER TREATMENT EQUIPMENT

The plus values that come with Roberts Filter equipment are intangibles of long experience, engineering skill and the ability to work with others.

We invite the opportunity to cooperate with individuals and organizations interested in the correction of water, either for municipal or industrial requirements. Your request will bring full information on the application of our products and services.

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640 COLUMBIA AVE., DARBY, PA.

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FOR IMMEDIATE DELIVERY AND PERMANENT JOINTS

Hydro-tite, the self-sealing, self-caulking, jointing compound can be supplied promptly in any quantity at any time from our warehouse stocks strategically located throughout the United States and Canada. Over thirty years of use has proved that pipe joints made with Hydro-tite, stay tight. Send for data book and sample.

ALWAYS USE FIBREX

The sanitary, bacteria-repellent paper packing that is used like braided jute. Seventy pounds of Fibrex takes the place of one hundred pounds of braided jute, with proportionate savings in cost. Send for sample.

HYDRAULIC DEVELOPMENT CORPORATION
Main Sales Office: 50 Church St., New York, N. Y.
Works: West Medford Station, Boston, Mass.

Personal Notes

L. M. Fisher, widely and favorably known to most everyone in the sanitary engineering field, has been appointed by President Truman as a member of the Interstate Commission on the Potomac River Basin, succeeding the late Ralph Tarbett. Mr. Fisher retired recently after a long and distinguished career in the Public Health Service.

M. M. Yarrington has been made general manager and F. C. Wittig assistant general manager of the Aeroil Products Co., West New York, New Jersey.

Jobs for Engineers

Design Engineers for bridges and subaqueous tunnels are needed by the Division of San Francisco Bay Toll Crossings, Room 500, 74 Montgomery St., San Francisco, Calif. Starting salaries range from $268 to $458 per month for a 40-hour week.

The California Division of Highways needs engineers for field and office work. Write to the Division, Sacramento, Calif.

The Portland Office, Corps of Engineers, Portland, Ore., Col. O. E. Walsh, district engineer, need civil, cartographic and structural draftsmen and engineering computing draftsmen. Entrance salaries range from $2644 to $3021.

Associate sanitary engineers are needed by the California State Personnel Board, 1015 L St., Sacramento, Calif., presumably for the State Health Department. An examination is necessary. Filing date is May 22; examination date is June 12. Non-residents are eligible. Salary range is $395, $415, $436, $458 and $481.

The U. S. Public Health Service will hold competitive examinations in June for appointments in the regular corps in the grade of 2nd Lt. Entrance pay is $3391. Application to June 1; examinations June 21-23. Write H. R. McCall, Senior Engineer, U. S. Public Health Service, Washington, D. C.

MANUFACTURERS' REPRESENTATIVE SEEKS CONNECTIONS—Graduate & registered engineer, formerly Manager for a Board of Public Works and Manager for an Oriental Power Company. Seeks representation for various municipal and utility equipment for areas in and surrounding Omaha, Nebr., and Denver, Colo. John M. Clema, 919 Oaklawn St., N.E., Grand Rapids 5, Mich.

HELP WANTED—(Men)

City Engineer and Director of Public Works for City of 15,500. Must have C.E. degree, know sewage and water. $4,500. Apply City Manager, Albert Lea, Minnesota.

REQUEST FOR BIDS

The City of El Paso, Texas, will open bids May 11, 1948, for the main contract covering construction of its downtown track separation project. Estimated cost—$2,000,000; 140,000 cu. yds. excavation; 14,000 cu. yds. concrete; 282,850 lbs. sheet steel piling; 260 tons of H-bearing piles, 640,000 lbs. reinforcing steel; 675,000 lbs. structural steel. Job expected to last about 2 years. DeLeuw, Cather & Co., Chicago, engineers. Public Works Engineer, El Paso, city official for information and correspondence.

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